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DRAFT ENVIRONMENTAL IMPACT STATEMENT

GUAM CLEANUP OF URUNO BEACH

FEBRUARY 1987

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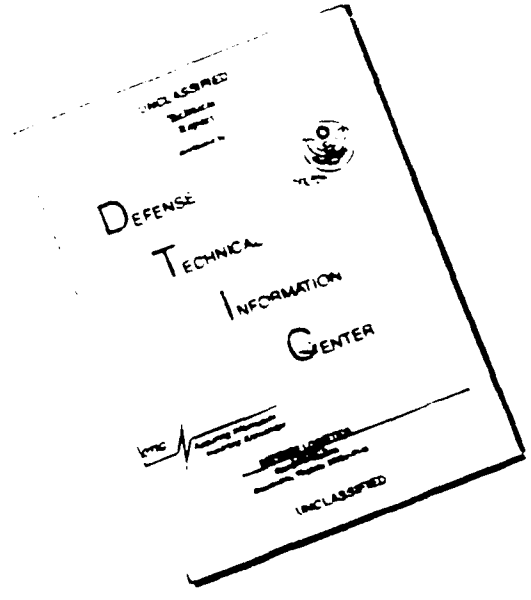

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DRAFT ENVIRONMENTAL IMPACT STATEMENT

GUAM CLEANUP OF URUNO BEACH

LEAD AGENCY
DEPARTMENT OF THE AIR FORCE
43RD COMMAND SUPPORT GROUP
ANDERSEN AIR BASE, GUAM

COOPERATING AGENCIES
DEPARTMENT OF INTERIOR, FISH AND WILDLIFE SERVICE
US ARMY CORPS OF ENGINEERS, PACIFIC OCEAN DIVISION

The following person may be contacted for additional information:

Vern Tobey
43rd Combat Support Group
SAC/DEEV
APO San Francisco, CA 96334
Phone: (671) 366-2101

The draft EIS will be made available on or about June 30, 1987 for review and comments. Comments should be sent to the above contact person.

In 1985, Congress directed the Secretary of the Air Force to cleanup debris dumped on the property by the U.S. Government to the satisfaction of the owners. Given this mandate, the U.S. Air Force to remove debris deposited by the military during the 1940's and 1950's from the project site. The alternatives considered are real estate acquisition of the private property which would not require cleanup; a total cleanup where either a cable system which requires a crane and dragline to haul debris up the slope of the cliffs for disposal or a bulldozer attached to a cable which would push the debris down the cliff to a staging area for the debris to be sorted and transported for disposal over land; minimal cleanup of ordnance and/or large debris; and no action. The debris would be disposed at a land disposal site on Andersen Air Force Base while the ocean disposal area has not been determined. Ordnance removal would also be included during the removal operations. The cleanup activities may impact the endangered Mariana crow, archaeological sites and pristine limestone forest areas. The ocean disposal route has been evaluated and was dropped further consideration because of the significant adverse impacts on the pristine marine environment, archaeological sites and the lack of an approved ocean disposal site.

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The bulldozer operation alternative consists of pushing all the debris to the bottom of the cliff using conventional dozing equipment attached to cables at the top of the hill. The cables would keep the equipment from rolling downhill and assist in pulling the dozers uphill. After accumulating material in staging areas at the base of the cliff area, the material would be sorted for any unexploded ordnance and trucked overland to the sanitary landfill at Andersen AFB. Construction of a temporary road from the top of the cliff to the bottom would be required for transport of the debris material. The ordnance would be disposed of at the demolition range on Andersen AFB.

The no action alternative would leave the property as is. Removal operations would not be done and the debris and ordnance will remain on the property.

Numerous tires were found throughout the area far away from the main disposal sites. These tires apparently rolled into the dense jungle after being dumped over the edge of the hill. The tires can be removed by piling them up at selected locations, cabling them together and lifting them out by helicopter. The tires could be carried directly to a disposal site on Andersen Air base or dropped at the top of the hill for removal by truck. The number of tires is estimated to be 6,000.

The ocean disposal route has been eliminated from further consideration. During the evaluation of the alternatives, the ocean route generated significant adverse environmental impacts on the pristine marine environment, pristine limestone forest and archaeological sites. In addition, an approved ocean disposal site does not exist in Guam.

Hazardous/toxic wastes are not anticipated because of the U.S. Environmental Protection Agency's participation in the past and their conclusions that there was no evidence of hazardous waste observed in the area.

C. ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

Removing the debris from the Artero property would impact the approximately 5 acres of native limestone forest and 2 acres of the pristine marine areas (if the debris is transported by the ocean route). The U.S. Fish and Wildlife Service has identified several species listed as endangered within the project site. Section 7 coordination under the Endangered Species Act has been initiated. The project site contains archaeological sites listed in the National Register of Historic Places and will require coordination with the Advisory Council of Historic Preservation and the Territorial Historic Preservation Officer. Selected removal of the debris will lessen the adverse impacts to the native forest and archaeological sites since the project will require minimal disturbance to the land. Unexploded ordnances blasted in place may cause significant environmental impacts to the limestone forest, endangered wildlife and possibly to the archaeological sites. Controlled blasting for ordnance detonation will be needed to reduce the environmental impacts. Of the total debris removal

alternatives, the cable system has the least environmental impacts on the pristine native limestone forest, archaeological sites and the endangered species than the bulldozer alternative.

D. UNRESOLVED ISSUES

Section 7 coordination of the Endangered Species Act has been initiated. The U.S. Fish and Wildlife Service has indicated that endangered species have been found in the project area. The project site has many archaeological sites which will require coordination with the Advisory Council of Historic Preservation and the Territorial Historic Preservation Officer.

E. ORGANIZATIONS AND PERSONS CONSULTED

During the field research for the project, all appropriate Government of Guam agencies were consulted including the Guam Environmental Protection Agency, Division of Aquatic and Wildlife Resources, Bureau of Planning and the Guam Historic Preservation Officer. The U.S. Navy, U.S. Fish and Wildlife Service and the U.S. Environmental Protection Agency were also consulted on this project.

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I. INTRODUCTION

This environmental impact statement will examine the impacts of removing the debris dumped by the U.S. Government during and after World War II from the privately owned property on Uruno Beach[1]. This directive was issued in FY 1985 Military Construction Authorization Act which stated:

> "This clean up operation should remove all materials generated by the federal government that are not desired by the owners and it should be completed at the earliest possible time."

On July 22, 1986, the Department of the Air Force issued a Notice of Intent to prepare an environmental impact statement (EIS) for the proposed action.

The Council on Environmental Quality (CEQ) requires that an EIS consider the environmental significance of the proposed action in respect to its context and intensity. Therefore, the proposed action must be analyzed for its potential long- and short-term impacts on the human environment, the affected region and locality. Ten criteria must be used in this analysis. They are:

1. beneficial and adverse impacts.
2. affects on public health and safety.
3. impacts on unique geographical features.
4. impacts on human environmental likely to be controversial.
5. level of uncertainty of impacts or risks to human environment.
6. precedent setting nature of the action.
7. contribution to significant cumulative impacts.
8. impacts on sites listed in or eligible for the National Register of Historic Places.
9. Degree to which endangered species or habitat may be affected.
10. whether the proposed action may violate an existing environmental law.

These criteria were considered during the assessment of impacts of the proposed action and alternatives, and are summarized in the findings of this EIS.

[1]Uruno has also been spelled "Urunao"

II. NEED FOR AND DESCRIPTION OF THE PROPOSED ACTION

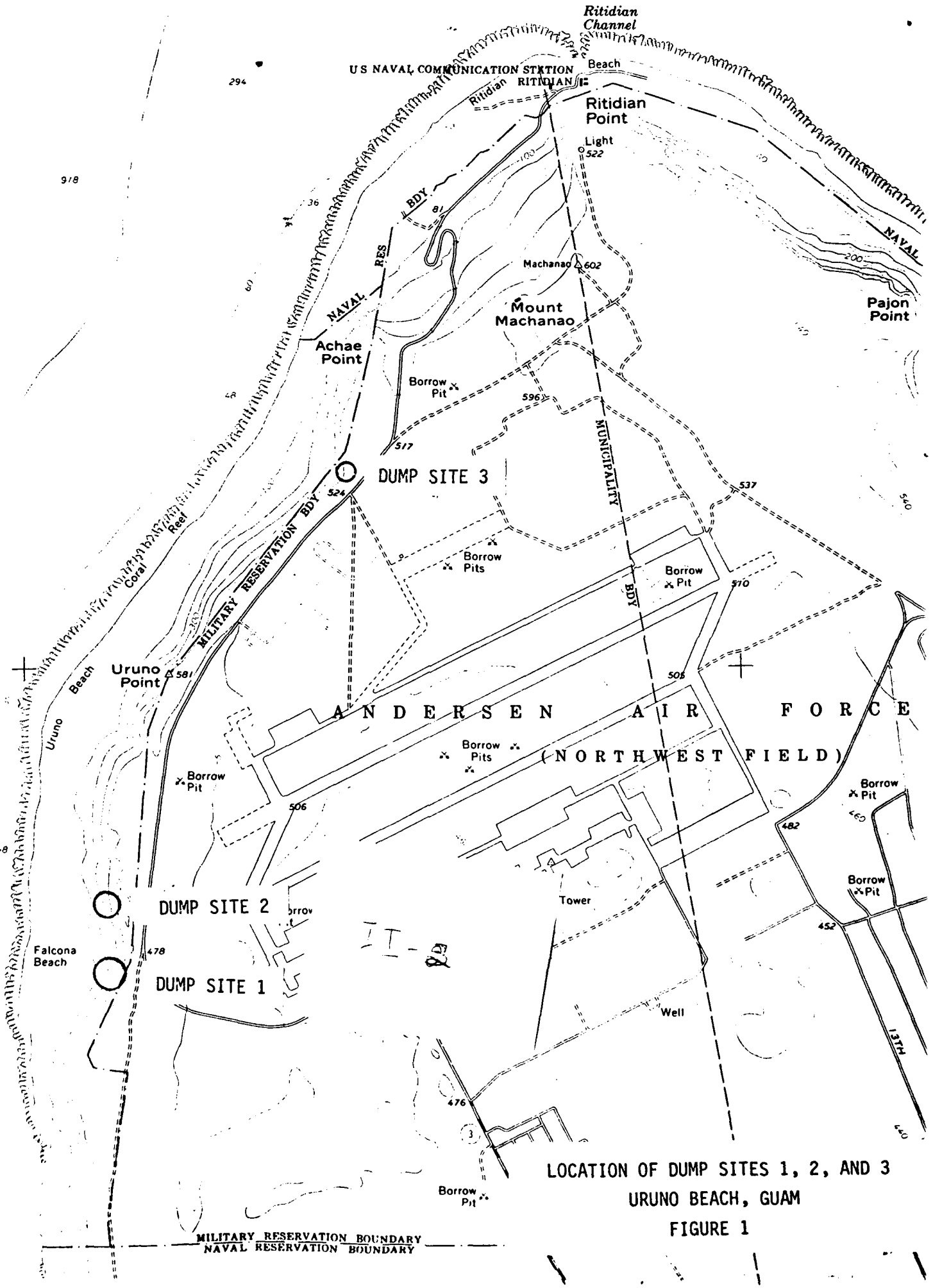
A. NEED FOR THE ACTION

Potentially three separate dump sites exist on the privately owned property of Uruno Beach (Figure 1). These sites contain tires, aircraft parts, rusted drums, scrap metal, pots, pans, vehicle parts, AN-M50 series incendiary bomblets, M-89 and 90 target identification bombs, small arms, remains of 100 lb. incendiary bombs, 55-gallon drums and other materials rusted beyond recognition. About 1 to 2 feet coral fill was placed on the dump sites to cover the dumped material. Numerous tires which rolled into the dense jungle after being dumped over the edge of the cliff from the main disposal sites are found also found throughout the area. The number of tires are estimated to be about 6,000.

Unexploded ordnances pose a threat to the health and well being of persons traversing these dump sites as well as to the property owners. Unsubstantiated reports from the landowners, the Artero family, suggest explosions have occurred during hot summer days; however, recent discussion with the Jesus Artero (pers. comm.) have revealed no explosions have been noted since the late 1950's or early 1960's. In addition, no documentation was found to support the allegations.

In August 1984, the Government of Guam Environmental Protection Agency (GEPA) completed assessment of three sites including the project site located outside of currently owned military properties on Guam where the US military disposed suspected hazards in the past. They recommended to the U.S. Environmental Protection Agency (EPA), Region IX in-depth assessments or mitigation actions and further requested an appropriate Superfund or Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) response be initiated. In the meantime, in November 1984, EPA referred the matter to the U.S. Army Corps of Engineers for the site to be included in the Defense Environmental Restoration Program (now known as the Defense Environmental Restoration Account or DERA).

EPA Region IX responded to GEPA requests by notifying the Emergency Response section which sent a member of the Technical Assistance Team (TAT), EPA On-Scene Coordinator (OCS) and the U.S. Coast Guard Pacific Strike Team (PST) to Guam to assess reported hazardous waste sites including the subject property. The U.S. Army Corps of Engineers also participated in the field investigation of this site. On March 2, 1985, EPA, TAT, and PST personnel conducted an observation walk and noted that there was no evidence of hazardous wastes seen in the area. An aerial survey on March 5, 1985 over the project site indicated that no evidence of any detrimental effects to the environment were observed by a member of PST and EPA. On March 7, 1985, the team returned to the Artero property. EPA concluded on March 8, 1985 that due to anticipated future action by military authorities, all immediate threats to the public and environment has been addressed. In addition, EPA's trip report by Chris Weden dated



LOCATION OF DUMP SITES 1, 2, AND 3
URUNO BEACH, GUAM
FIGURE 1

March 18, 1985 (see Appendix A) indicated that they were acting on the information obtained from GEPA and concluded:

> "This information was inaccurate and grossly overstated the hazard of potential sites....Empty deteriorated drums or gas cylinders do not constitute an imminent or substantial threat to public health or the environment, nor does the fact that an area has been simply backfilled over military debris."

As a result, hazardous/toxic wastes are not anticipated because of EPA's participation in the past and their conclusions that there was no evidence of hazardous waste observed in the area.

While the project did not qualify under Superfund (CERCLA), the project was listed in the Defense Environmental Restoration Account (DERA) for debris removal. During coordination with the Navy and the Air Force by the Corps of Engineers, the subject cleanup action was discussed in September 1985. The Air Force indicated that they had a Congressional mandate to cleanup the property and requested assistance from the Corps of Engineers. It was later decided that the Air Force would take the lead for the cleanup action under the Installation Restoration Program (IRP). The U.S. Army Corps of Engineers, Pacific Ocean Division is providing technical evaluation and support assistance for the Air Force.

Access to the project area is very limited. The property cannot currently be reached by ocean going vessels nor can access be obtained from land transportation due to the lack of roads leading to Uruno Beach. In addition, no landing strip for aircraft exists on the property. Artero family members can gain access through Andersen Air Force Base after complying with security precautions. Figure 1 illustrates the relatively isolated dump sites where they are bordered by the ocean and government owned lands.

The landowners in the past have proposed the project area for resort development, which if completed, would increase the potential exposure and risk to the public on their human health. Risk to wildlife and vegetation is not significant.

B. DESCRIPTION OF THE PROPOSED ACTION

The project site is a ribbon shaped tract of land over a mile long and only a few hundred years wide and lies approximately north-south in an area identified as Uruno Point, Guam. Three military facilities border the site which includes Northwest Field (part of Andersen AFB) to the west, the Naval Communications Station Ritidian Point to the north and the Naval Communications Station Finegayan to the south. All of these facilities contain highly sensitive military communications sites and satellite tracking antennas. The proposed action is to fulfill the Congressional directive which directs the Secretary of the Air Force to cleanup

approximately 431.06 acres on property identified as Lot No. 10080. The cleanup operation should remove all materials generated by the Federal Government that are not desired by the owners. This EIS evaluates the various alternative methods and actions to fulfill the directive.

III. ALTERNATIVES INCLUDING THE PROPOSED ACTION

A. GENERAL

The cleanup areas are identified as Dump Site 1, Dump Site 2 and Dump Site 3 as shown on Figure 1. Dump Site 1 is approximately 6 acres and contains roughly 48,000 acre-feet in volume (Figure 2). Dump Site 2 occupies about 5 acres or approximately 40,000 acre-feet of debris (Figure 2). Dump Site 3 is composed of 2 acres or about 16,000 acres-feet of debris (Figure 3). The dump sites are on the edge of a steep cliff. The cliff area is composed of limestone with numerous ledges.

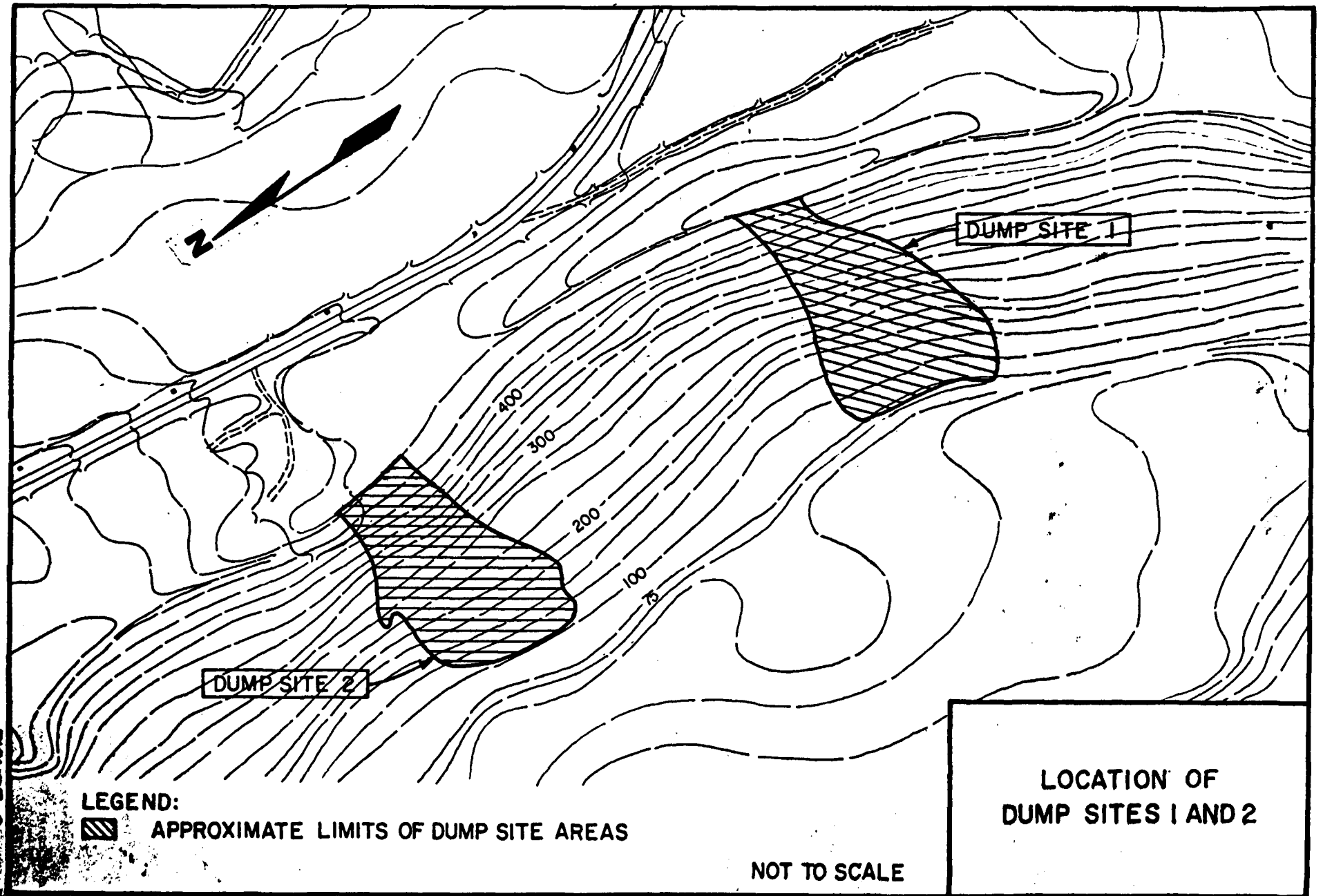
Each alternative, other than the no action alternative, will require a detailed land survey to determine ownership of each dump site, ordnance clearance and sampling to determine the presence of any hazardous waste. An archaeological survey would be required for each alternative except for the no action and real estate acquisition alternatives. After a careful review of aerial photos and various maps, it would appear that Dump Site 3 is located on existing Andersen Air Force property. It would also appear from the U.S. Environmental Protection Agency report and the on-site survey that hazardous wastes are no longer present other than military ordnances. These assumptions, however, cannot be accepted without a detailed land survey and sampling. The sites are not in the aquifer recharge area as identified by the Guam Bureau of Planning report.

The costs of each alternative, however, were developed assuming that no hazardous wastes (other than ordnances) were involved, and the debris could be transported to Andersen AFB for disposal at their EOD range.

Overland transportation and disposal at Andersen AFB is used in all cases of removal. An approved ocean dump site does not exist for Guam and transportation using a landing craft could not be completed without significant harm to the marine and terrestrial environment. The ocean disposal alternative would require a harbor to be dredged and constructed which would cause significant damage to the coral and marine life in the sensitive marine ecological area. In addition, land transportation to the ocean from the base of the cliff would require additional acres of limestone forest to be destroyed for the construction of a temporary road. The limestone forest serves as a habitat for the endangered Mariana crow. Near the beach area, significant archaeological sites listed on the National Register of Historic Places would be also be adversely affected by the ocean disposal alternative.

B. REAL ESTATE ACQUISITION

Real estate acquisition of Lot No. 10080 of approximately 431.06 acres from the landowners is the preferred alternative. Although the method of acquisition has not been determined, it could include purchase of the property from the landowners or land exchange. In April of 1986, the Air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DUMP SITE 1
DUMP SITE 2
400
300
200
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75
LEGEND:
APPROXIMATE LIMITS OF DUMP SITE AREAS
NOT TO SCALE
LOCATION OF
DUMP SITES I AND 2

FIGURE 2

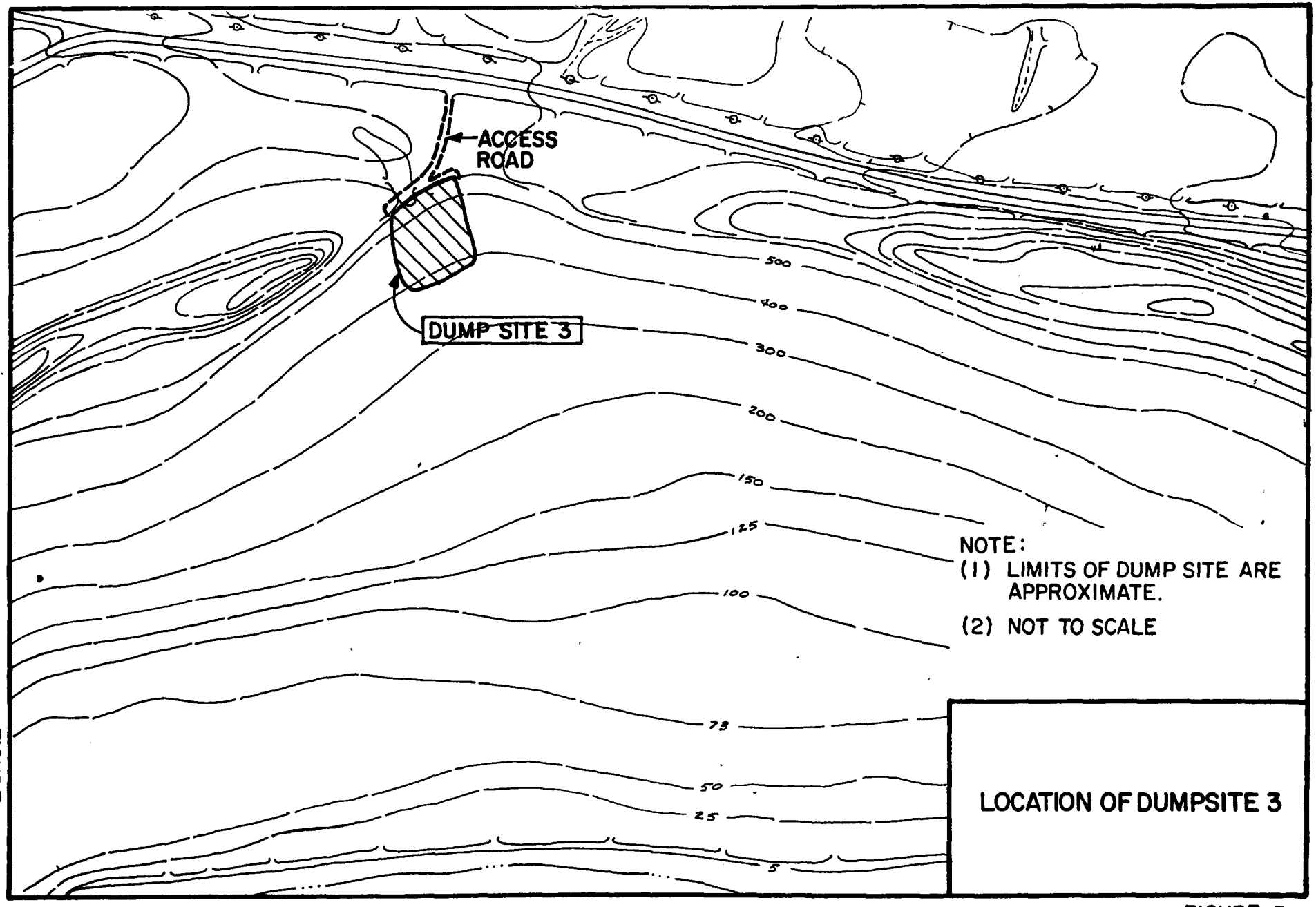


FIGURE 3

FIGURE 3

Force, through its real estate agent, Naval Facilities Engineering Command, commission a contract appraisal from the Honolulu firm of Hastings, Martin, Conboy, Braig, and Associates. The appraisal study determined that the highest and best use of the property would be to sell it as an island and valued the property at $1,350,000. The study also considered the property on the assumption that the Artero family possessed only a nontransferable permit to cross Air Force property for family recreation purposes and that any developmental was prohibited. This appraised value for this scenario was determined to be $430,000.

The real estate acquisition alternative would require further studies. Land surveys are required to determine the exact boundaries and to determine whether Dump Site 3 is on private or Andersen AFB property. Sampling for hazardous wastes would be necessary. Cleanup work, however, would not be required because the debris would no longer be on private property.

Positive benefits to the environment from this alternative would be derived since there will be less disturbance. These benefits include no disturbance to the endangered species or habitat, native limestone forest, and archaeological sites; protection of public safety from restricted access; no potential for demolition/explosive accidents; and the elimination of conflicts with the existing and future mission of military activities in that area. The negative benefits generated include the lack of cleanup action and no further archaeological studies of an area rich in cultural resources will be conducted.

Table 1 compares the cost estimate of this alternative to other alternatives considered in this EIS.

C. MINIMAL CLEANUP

The minimal cleanup alternative would include removal of ordnances and/or removal of large debris items such as aircraft parts, tires, a truck, dumpsters, and boilers. In January of 1986, a survey was conducted by the 2701st Explosive Ordnance Disposal Squadron from Hill Air Force Base, Utah found AN-M50 series incendiary bomblets, M-89 and 90 target identification bombs, small arms and remains of 100 lb. incendiary bombs. Additionally, a survey in the an area other than the major dump site resulted in two live MK fragmentation grenades and 30 rounds of small arms which dated back to World War II. At the bottom of the cliff area, Japanese ordnance was found as well.

1. Removal of Ordnance Only. The removal of ordnances only would occur on all the dump sites and would involve surface clearance. The ordnances would be transported to Andersen AFB for disposal on the ordnance range. It is anticipated that ordnance removal would be conducted by the Air Force EOD teams. Dump Sites 1 and 2 will require staging areas in which Dump Site 1 staging area would be on Andersen Air Force property. Dump Site 2 proposed staging area would be located on Artero property. The ordnance would be removed from the property and brought up to the

staging area where it would then be transported within Andersen AFB property to the ordnance range for disposal. In some cases where live ordnance is in an unstable deteriorated condition, the ordnance would be detonated in place as a safety precaution.

Depending on the method of ordnance clearance such as using a cable system or manual extraction, the length of time required to complete the job ranges from 6 months to 30 days respectively. The number of the persons required for the removal of ordnance is approximately 100 persons for the manual extraction and about 25 persons using a cable system approach. The cost for manual extraction has been estimated at approximately $204,000 by the 2701st EOD squadron. The ordnance removal cost for the cable system has been estimated at approximately $351,000. The use of helicopters for the removal operations is not anticipated.

An archaeological reconnaissance conducted in July 1986 revealed that the area is rich in archaeological sites. Ordnance removal and clearance operations may adversely affect some of these sites, further archaeological surveys would be required for compliance with the Sections 106 and 110 of the National Historic Preservation Act. Dump Site 3 would not require further studies since no archaeological sites were found.

2. Ordnance Clearance and Removal of Large Debris Material. In addition to ordnance cleanup as previously described, removal of large debris items such as tires, aircraft parts, vehicle parts and boilers could be another aspect of the minimal cleanup alternative. Tires could be rolled to a specified area, grouped and hauled away via helicopters. Large bulky items could be reduced in size by using a cutting torch and then hauled away be either a helicopter or dragline. The debris material would then be transported to the sanitary landfill at Andersen AFB.

Because the area is rich in archaeological sites and ordnance removal activities may adversely affect some of these sites, further archaeological surveys would be required for compliance with Sections 106 and 110 of the National Historic Preservation Act. Dump Site 3, however, would not require further studies since no archaeological sites were found.

Revegetation of the area would not require since the affected area of both the ordnance clearance activity and the removal of large debris items is not significant. The affected area may be in small pockets where natural revegetation could easily occur.

The cost estimate for this alternative is illustrated on Table 1.

D. COMPLETE CLEANUP - CABLE SYSTEM

Prior to initiating the debris removal operation on all three dump sites, surface ordnance clearance will be undertaken to eliminate some of the hazards. Air Force EOD teams will survey the area and will remove any unexploded ordnance found. The ordnance will be taken to the ordnance range on Andersen AFB for demolition. The number of persons required for

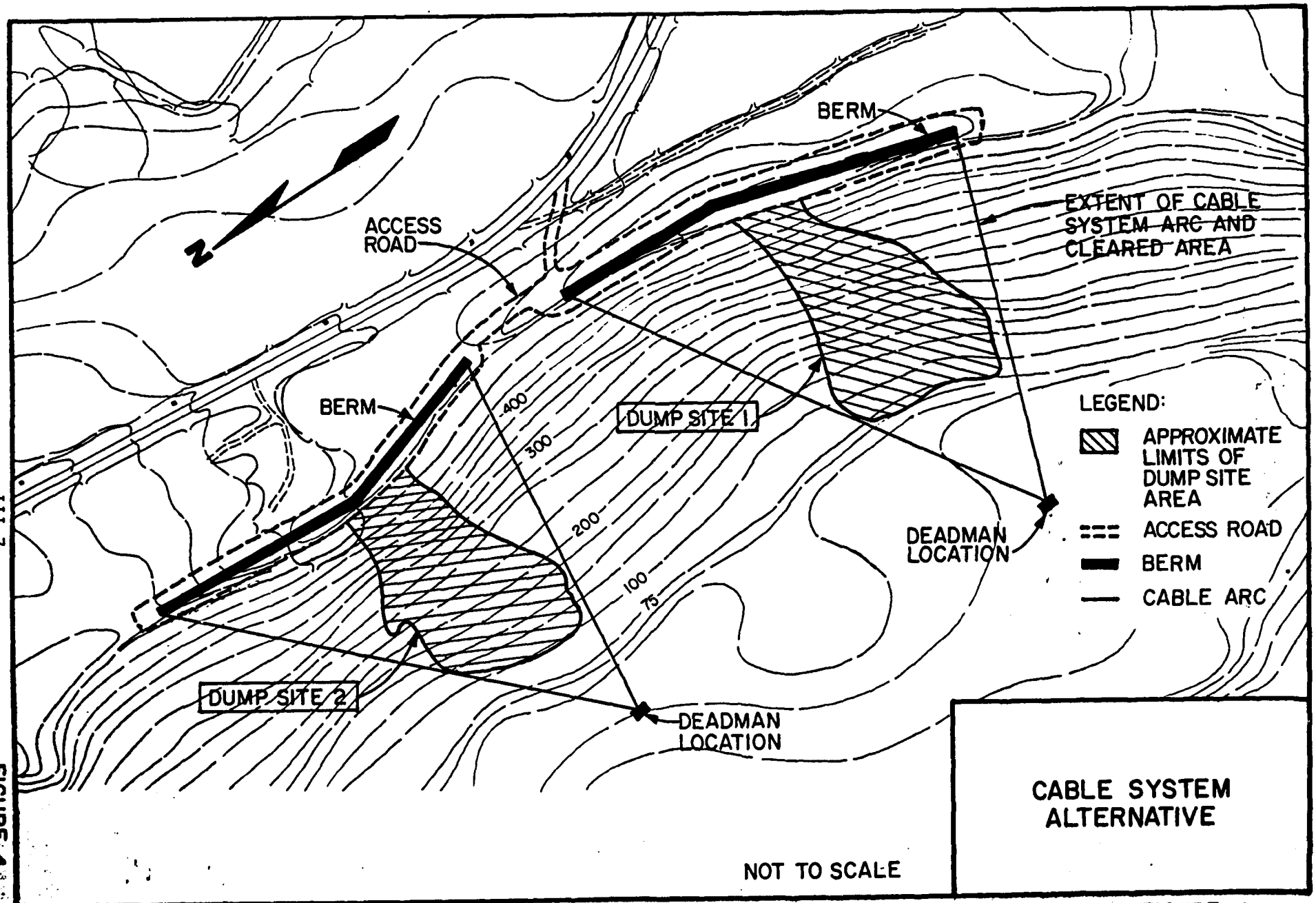
the EOD survey has not been determined, however, the amount of persons is not expected to significant have an impact on the local population of Guam because of the significant number of tourists that visit Guam each year. Guam has over 400,000 visitors a year. The personnel required for this action would comprise less than 0.01 percent of the annual number of visitors and would not provide any hardship on visitor accommodations.

1. Dump Sites 1 and 2. The cable system involves using a large construction crane, Manitowoc 4600T, with a short boom and one end of the crane's cable attached to a 20-foot high deadman anchor at the bottom of the hill in order to remove approximately 88,000 cubic yards of material in Dump Sites 1 and 2 (Figure 4). The deadman anchor would be lowered into position by a helicopter. With the crane's cable anchored at the bottom, this system would allow a bucket attached to the cable to move freely up and down the hill and could be raised and lowered to grab debris and carry it to the top of the hill. The bucket could be repositioned on the hill by moving the mobile crane. The crane operators would work in two shifts per day, 6 days per week. Observers safely placed away from any hazards would assist the crane operator in positioning the bucket. Helicopters would be used not only for positioning the deadman anchor but also be removal of tires and large debris items. As previously stated in the minimal clean alternative, the tires would be rolled to a specified location, grouped together for hauling via helicopter. Large debris would also be reduced in size by a cutting torch and hauled out via helicopter or by the cable system depending on the location of the debris. Figure 5 illustrates the cable system alternative.

This alternative includes an earth barrier located at the top of the cliff area between the crane and hillside to protect personnel from ordnance explosion hazards. The 10-foot high earth barrier would be approximately 1,000 and 900 feet for Dump Sites 1 and 2 respectively. After use of the barrier at one dump site, it could be removed and reused for another area. Material would be dumped between the earth barrier and the crest of the hill for sorting prior to loading unto truck for disposal.

An Air Force explosive ordnance detachment (EOD) specialist would be on-hand to sort the debris materials that has been picked up from the dump site and deposited in front of the berm. Any ordnance found in the material would be transported to the ordnance range on Andersen property for demolition. The rest of the debris material would be transported to a sanitary landfill on Andersen AFB. The amount of material from Dump Sites 1 and 2 to be dumped into the landfill would be nearly 5.45 percent of the landfill capacity or equivalent to approximately one-half year of the landfill's life. The landfill capacity is approximately 1,694,000 cubic yards with 7 cells, 21 feet deep. Current disposal rates are approximately 754 tons per year. The landfill has approximately 8 years before it is filled to its capacity. It should be noted that the debris material will be tested for hazardous waste. Although it is not anticipated, sampling will be done prior to the wastes being disposed at the sanitary landfill.

The cable system uses conventional equipment and the concept has been used successfully by the mining industry. No access is needed from the Artero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ACCESS ROAD
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BERM
400
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200
100
75
DUMP SITE 1
DUMP SITE 2
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DEADMAN LOCATION
LEGEND:
APPROXIMATE LIMITS OF DUMP SITE AREA
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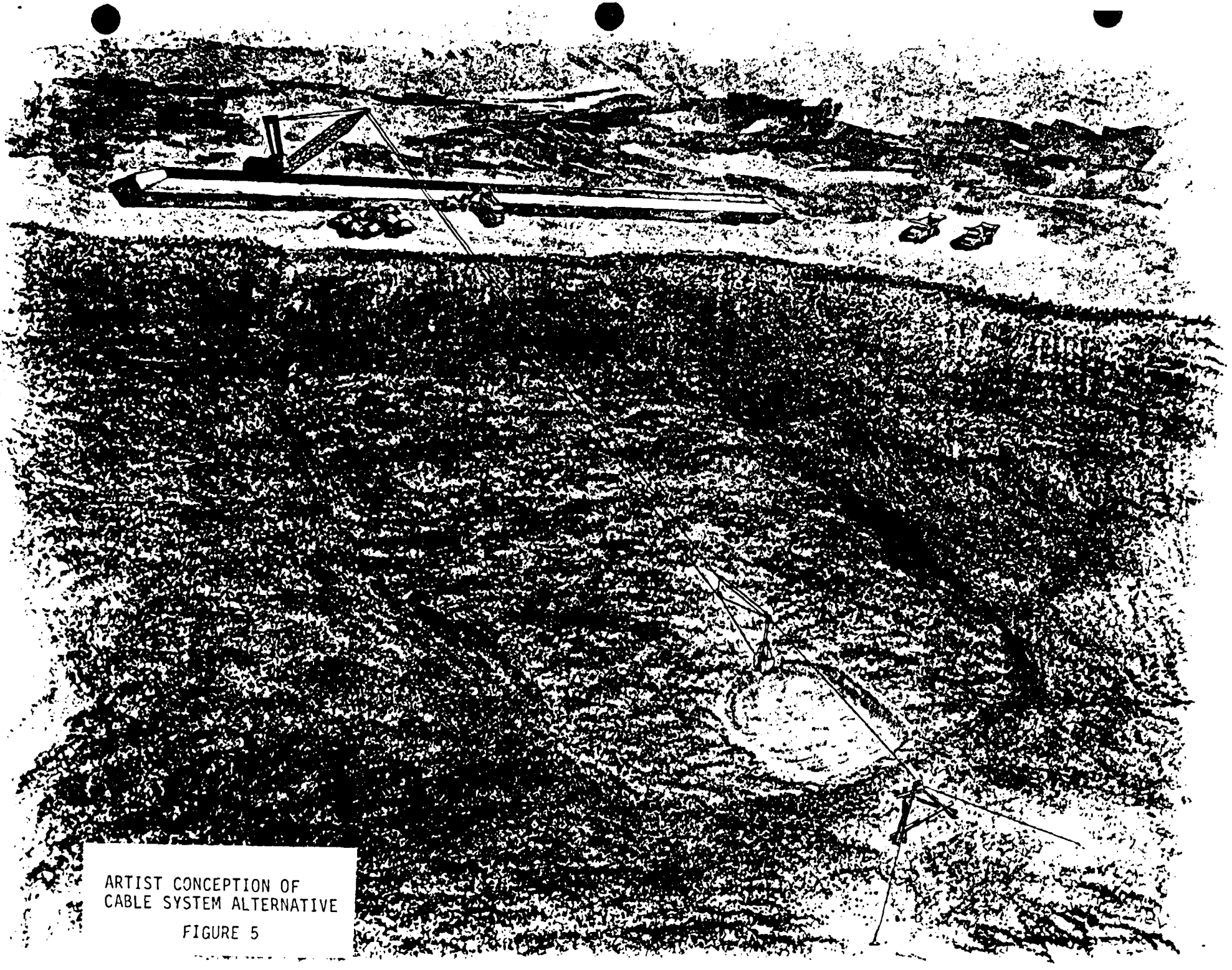
CABLE ARC
CABLE SYSTEM ALTERNATIVE
NOT TO SCALE

FIGURE 4



ARTIST CONCEPTION OF
CABLE SYSTEM ALTERNATIVE

FIGURE 5

property to Andersen AFB and all material would be brought to the top where it could be removed using existing roadways. Vegetation would be cleared at the anchor area and in areas where the cable arc overlaps natural forest land and the dump site. Approximately two additional acres of forest would be removed in this alternative. Atop the cliff area, a staging area would be required. For Dump Site 1, the area would be located on Air Force property. The area for Dump Site 2 would be located on Artero property.

The cable system appears to be the least hazardous method of removal. The operator would be protected from explosions by an earth berm and the dumped material could be observed for ordnance from a distance before sorting and final disposal. The same construction equipment could be used for all three dump sites The mobile crane may be large enough to clean Dump Site 3 (the smallest site) from the top of the hill without use of a deadman anchor downslope.

The cleanup operation would require approximately 1,900 man days for the Dump Site 1 and approximately 1,600 man days for Dump Site 2. The estimated construction period is to be 18 months for cleanup of all three dump sites.

Land surveys would be required to determine the boundaries of the dump sites and property boundaries. Archaeological surveys would be required since the staging areas would affect some found during the July 1986 reconnaissance and to meet the requirements of the National Historic Preservation Act.

2. Dump Site 3. Dump Site 3 could use the same large crane such as the Manitowoc 4600T for the debris removal operation, however a deadman anchor would not be required. Dump Site 3 is smaller than the other two dump sites and is approximately 16,000 cubic yards. The crane can be operated for normal excavation. The 10-foot high earth barrier protecting the crane operator could be reused from the other dump sites. The barrier would only approximately 300 feet in length. Personnel would be require to spot the bucket for the excavation operation. Approximately 700 man days would be required for this removal operation. The staging area would occur on Andersen AFB property. No additional acres would be require to remove the debris from this dump site.

As previously indicated above, surface clearance of ordnance would occur prior to excavation operation. An EOD specialist would also be required to sort the buckets of material dumped between the barrier and the hillside for ordnance prior to the material being trucked to the sanitary landfill on Andersen AFB. Any ordnance found would be taken to Andersen 's ordnance range for proper disposal.

The inert material will be transported to Andersen's sanitary landfill for disposal. Although hazardous wastes are not anticipated, sampling for hazardous wastes will be done prior to disposal in a landfill. The amount of material would be approximately 1 percent of the landfill's capacity.

A land survey would be required for Dump Site 3 to determine whether the site is situated on Andersen Air Force property or if the dump site is on private property archaeological studies would not be required based on the surveys conducted during July 1986.

3. Cost Estimate. Table 1 details the cost estimate for this alternative.

E. COMPLETE CLEANUP - BULLDOZER OPERATION

Prior to the bulldozer operation, surface ordnance clearance will be done for assure safety of the bulldozer operator. Dump Sites 1 and 2 would require the use of the bulldozer operation. The bulldozer operation would consist of pushing all debris to the bottom of the hill using conventional dozer equipment attached to a cable at the top of the cliff. The cable would keep the equipment from rolling downhill and would assist in pulling the dozers uphill. The bulldozer will travel from a height of over 400 feet in elevation to approximately a 100 feet. A temporary, winding road consisting of coral material, approximately 3000 feet in length with a maximum grade of 15 percent and one lane width with turn ins would be constructed from the top of the hill to the bottom of the hill to haul debris. After accumulating material in staging areas at the bottom of the hill, the material would be sorted and trucked to the top of the hill for disposal. The staging areas for Dump Sites 1 and 2 would be connected with an access road along the base of the hill. The bottom of the dump sites would need to be cleared to act as a staging area. Approximately fourteen acres of forest area would be required for the staging areas and the road for Dump Sites 1 and 2. This roadway would be expensive and difficult to build because of the steep grade and limestone cavities present in the hill slope (Figure 6). This alternative includes removal of the road upon completion of the project.

To avoid possible accidents or potential hazards, training of personnel will be necessary to assure safe operations. The sheer steepness of the slope would subject the bulldozer operator to some hazards. The bulldozer will be attached to strong cable(s) anchored from the top of the cliff area. The number of anchors depends upon the size of the bulldozer used in the operation. The cables would allow the bulldozer to proceed at a slow rate down the cliff face and would also aid in moving the bulldozer up the cliff. Pushing the material to the bottom of the hill may also be a hazardous operation because of possible unexploded ordnance hidden below the surface of the disposal areas. Once the material is pushed to the bottom of the hill, the material would have to be sorted by Air Force EOD personnel before loading onto trucks for transport up the hill for disposal.

Dump Site 3 would be cleaned by use of a crane as described in the last alternative. The crane, using an earth barrier would excavate the debris, bring it atop the cliff area, dump it between the cliff and the barrier for inspection of ordnance by Air Force EOD personnel. The ordnance would be

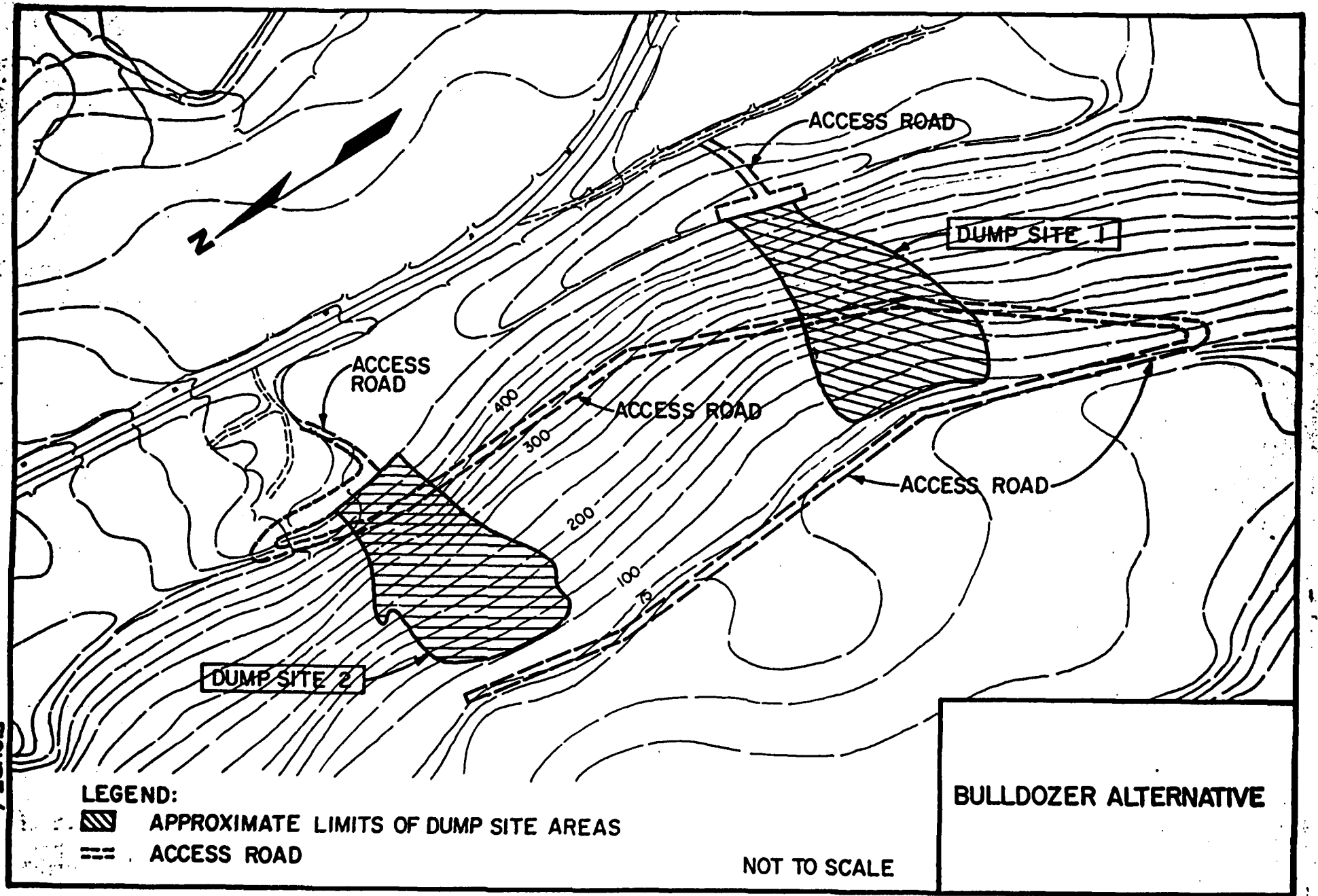

ACCESS ROAD
DUMP SITE 1
ACCESS ROAD
ACCESS ROAD
ACCESS ROAD
400
300
200
100
75
DUMP SITE 2
LEGEND:
APPROXIMATE LIMITS OF DUMP SITE AREAS
ACCESS ROAD
NOT TO SCALE
BULLDOZER ALTERNATIVE

FIGURE 6

disposed at the ordnance range on Andersen with the rest of the debris material transported via trucks to Andersen's sanitary landfill.

Tires can be rolled to the staging areas for trucking to the sanitary landfill on Andersen. Cutting torches can reduce the size of bulky items for easily transport to the staging areas and landfill.

The amount of debris material would be approximately 48,000, 40,000 and 16,000 cubic yards of material for Dump Sites 1, 2 and 3 respectively. The disposal of the debris in the Andersen sanitary landfill is estimated to use approximately six months of the life of the landfill or approximately 6.45 percent of the landfill space in total.

The amount of people required for this operation would not significantly stress the socioeconomic environment of Guam. In comparison to the visitor industry of approximately 400,000 visitors per year, the addition of 50 persons to do the work is not deemed to be significant. The construction period os estimated to be about 18 months with a work schedule of two 8-hour shifts per day, 6 days per week.

Land surveys will be required to determine the extent of the dump sites as well as the boundaries of the project area and the access road. Further archaeological surveys would be required to comply with Sections 106 and 110 of the National Historic Preservation Act. An archaeological reconnaissance survey in July 1986 revealed that the staging areas for this alternative would affect archaeological sites. Dump Site 3, however, would not require any further archaeological surveys. Although hazardous wastes are not anticipated, sampling of the debris material will also be necessary to determine if the material contains any hazardous wastes.

Table 1 shows the estimated cost for this alternative. Revegetation of the area has been evaluated and it was determined that revegetation is not feasible. The US Fish and Wildlife Service indicates that revegetation of the forest area would be difficult and has not been successfully done in the limestone forest. Although it is not a desirable impact, the revegetation process could occur naturally with the tendency of exotic species moving into the exposed areas. As a result, cost estimate does not reflect revegetation.

F. NO ACTION

The no action alternative, the environmentally preferable alternative, consists of leaving debris as is. No removal of debris or any unexploded ordnance would occur. In the 1950's, members of the Artero family reported that fires and explosions occurred in the dumped areas. Since then, no fires and explosions have been reported The area has remained unused. Over the years, the debris has been covered by vegetation and remains hidden from view. The easiest way to spot the areas of the debris is by the changes of vegetation cover. A definite change in vegetation patterns

occurs which outlines the disposal areas. The no action alternative would preserve the pristine forest areas since the environment would not be altered.

No action alternative, however, does not fulfill the Congressional directive whereby the Secretary of the Air Force is directed to remove the debris from the private property.

G. OTHER CONSIDERATIONS

1. Tire Disposal. Numerous tires were found throughout the jungle far away from the main disposal sites. These tires apparently rolled into the jungle after being dumped over the edge of the hill. The tires can be removed by piling them up at selected locations, cabling them together, and lifting them out by helicopter. The tires could be carried directly to a disposal site on Andersen AFB or dropped at the top of the hill for removal by truck. The number of tires is estimated to be about 6,000.

2. Disposal of Material. Disposal of the debris material will depend on its composition. If the material is nonhazardous, the material can be dumped in the Andersen Air Force Base landfill after ordnance is removed. The material would be tested prior to any disposal in the sanitary landfill. The ordnance can be disposed of in a burn pit potentially sited at Northwest Field or taken to the EOD disposal range on Andersen AFB. Based on reports from the US Environmental Protection Agency, hazardous wastes are not anticipated. If the material is hazardous, additional disposal consideration are required. Because of the lack of an ocean disposal site and the high costs, ocean disposal has been considered but is highly unlikely that this disposal method will be used.

3. Radiation. Radiation from antennas at Andersen AFB may present a safety hazard. A lead shield surrounding the crane cab may be required to keep radiation from affecting the construction workers. Radiation hazards would be more fully assessed during the next phase of the study.

4. Archaeological Survey. The project site is located within a national historic registered site and will require an archaeological survey to satisfy the requirements under the National Historic Preservation Act. The costs are reflected in the cost estimate on Table 1.

5. Ordnance Clearance. Ordnance removal activities for the cable system and bulldozer alternatives requires not only a surface clearance but also manual extraction.

TABLE 1. COST ESTIMATE

REAL ESTATE ACQUISITION FROM THE ARTERO FAMILY		
Real Estate Appraisal		$ 1,350,000
	TOTAL	$ 1,350,000
MINIMAL CLEANUP ALTERNATIVE		
Removal of Ordnance Only		$ 351,000
Archaeological Survey		39,000
	TOTAL	$ 380,000
Removal of Ordnance		$ 351,000
Removal of Large Debris Items/Tires		250,000
Archaeological Survey		39,000
	TOTAL	$ 630,000
CABLE SYSTEM ALTERNATIVE		
Dump Sites 1 and 2 Only		
Mobilization and Demobilization		$ 170,000
Earth Berm		75,000
Remove Tires		150,000
Set Up Slackline Cable		120,000
Excavate		1,878,000
Removal of Ordnance		406,000
	SUBTOTAL	$2,799,000
Contingency (25%)		700,000
	SUBTOTAL	$3,499,000
Engineering and Design		$ 201,000
Supervision and Administration (6.5%)		277,000
Archaeological Survey		50,000
	TOTAL	$4,027,000

Dump Site 3

Mobilization and Demobilization/Slackline		$ 40,000
Earth Berm		10,000
Excavate		342,000
	SUBTOTAL	$ 392,000
Contingency (25%)		98,000
	SUBTOTAL	$ 490,000
Engineering and Design		$ 34,000
Supervision and Administration (6.5%)		32,000
	TOTAL	$ 560,000

BULLDOZER ALTERNATIVE

Dump Sites 1 and 2

Mobilization and Demobilization		$ 200,000
Remove and Dispose of Debris		2,000,000
Road Construction and Demolition		950,000
Remove Ordnance		406,000
Remove Tires		150,000
	SUBTOTAL	$3,706,000
Contingency (25%)		927,000
	SUBTOTAL	$4,633,000
Engineering and Design		$ 290,000
Supervision and Administration (6.5%)		301,000
Archaeological Survey		75,000
	TOTAL	$5,299,000

Dump Site 3

Mobililization and Demobilization/Slackline		$ 40,000
Earth Berm		10,000
Excavate		342,000
	SUBTOTAL	$ 392,000
Contingency (25%)		98,000
	SUBTOTAL	$ 490,000
Engineering and Design		$ 34,000
Supervision and Administration (6.5%)		32,000
	TOTAL	$ 560,000

NOTE:

30 Helicopter Days	Furnished by AAFB
Full Time Ordnance Expert	Furnished by AAFB
Ordnance Disposal Service	Furnished by AAFB

ASSUMPTIONS:

a. A Guam based contractor will perform the work and will mobilze a large crane from the mainland U.S. 1/

b. Construction period is estimated at 18 months for both the cable and bulldozer alternatives.

c. Work schedule will be two 8-hour shifts per day, 6 days per week.

d. Dump Site 3 can be cleaned from the top without use of a deadman located downslope. 1/

e. The Air Force will provide 30 helicopter days for removal of the tires and placement and removal of materials at the base of the hill at no cost to the contractor.

f. A full time ordnance expert will be supplied by the Air Force to check each batch for ordnance at no cost to this contract.

g. Revegetation of the cleaned areas is not included in this cost estimate.

h. Borrow and disposal sites will be located on Andersen Air Force Base at no cost to the contractor, assuming that there is not hazardous wastes.

i. Estimated quantities are based on EOD report of 13 contaminated acres with a 5-foot thick layer of material.

j. Down time is 20 percent.

k. Contractor can remove 200 yards of material per day with each batch checked for ordnance. 1/

l. Material for the 10-foot high berm will be reused for each site. 1/

m. Engineering and design costs include plans and specifications and engineering during construction.

n. Supervision and administration costs are based on Corps of Engineers inspection and office administration during construction.

1/ cable system

IV. DESCRIPTION OF THE AFFECTED ENVIRONMENT

A. INTRODUCTION

Guam, the southernmost and largest of the Mariana Islands (Figure 7), lies 13 degrees 28 minutes north latitude and 144 degrees 44 minutes east longitude and is approximately 3810 statute miles west of Honolulu; 1,720 miles east of Manila; and 1,550 miles south of Tokyo. It is approximately 30 miles long and tapers in width from 8.5 miles in the north to 4 miles at the central part and widening again in the south to a maximum width of 11.5 miles from Orote Point to Ylig Bay. The total land area of Guam is 209 square miles.

The island of Guam is a territorial possession of the United States with self government. The people of Guam are U.S. citizens.

The project site is located on the northwest part of Guam (Figure 1). It is approximately 9.9 miles from the Guam International Airport and approximately 13.7 miles from Agana. The site identified as Lot 10080 occupies approximately 34.6 acres with about 2.05 miles of shoreline. It is bordered by military installations on three sides, NACAMS WESTPAC FINEGAYAN (naval communication station) to the south, several small local ranch type dwellings and NAVFAC to the north and Andersen Air Force Base (AAFB) to the west. The fourth side is the Philippine Sea.

Prior to February 13, 1926, the landowner of Estate No. 3661 known as Lot 10080 now was Vicente Roberto Herrero who sold his lot to Jose M. Taitano on that date. The lot was later sold at public auction to the Bank of Guam on February 21, 1939. The Artero family purchased to lot from the Bank of Guam and was presented the deed on September 16, 1941.

The project site is presently undeveloped. The site consists of a strip of coastal land approximately 1500-2000 feet wide and over 2 miles long. The elevation varies from sea level to 560 feet to limestone forest cliffs. The slope of the property is approximately 60 percent in some areas. The main focus of concentration is the cliff area where debris was dumped over these cliffs during and after World War II by the military. The amount of material is estimated to be 104,000 cubic yards. The disposal areas are estimated to occupy 13 acres with an average depth of 5 feet (Figures 2 and 3). Debris included parts of aircrafts, tires, scrap metal, AN-M50 series incendiary bomblets, M-89 and 90 target identification bombs, small areas and remains of 100-pound incendiary bombs, truck, vehicle parts, pots, pans, silverware, 55 gallon drums and other items rusted beyond recognition. Tires which have the ability to roll down the cliff area are also scattered throughout the base of the cliff area.

The proposed action is to cleanup the debris from the cliff area and any other place where debris is found which was caused by military actions. A

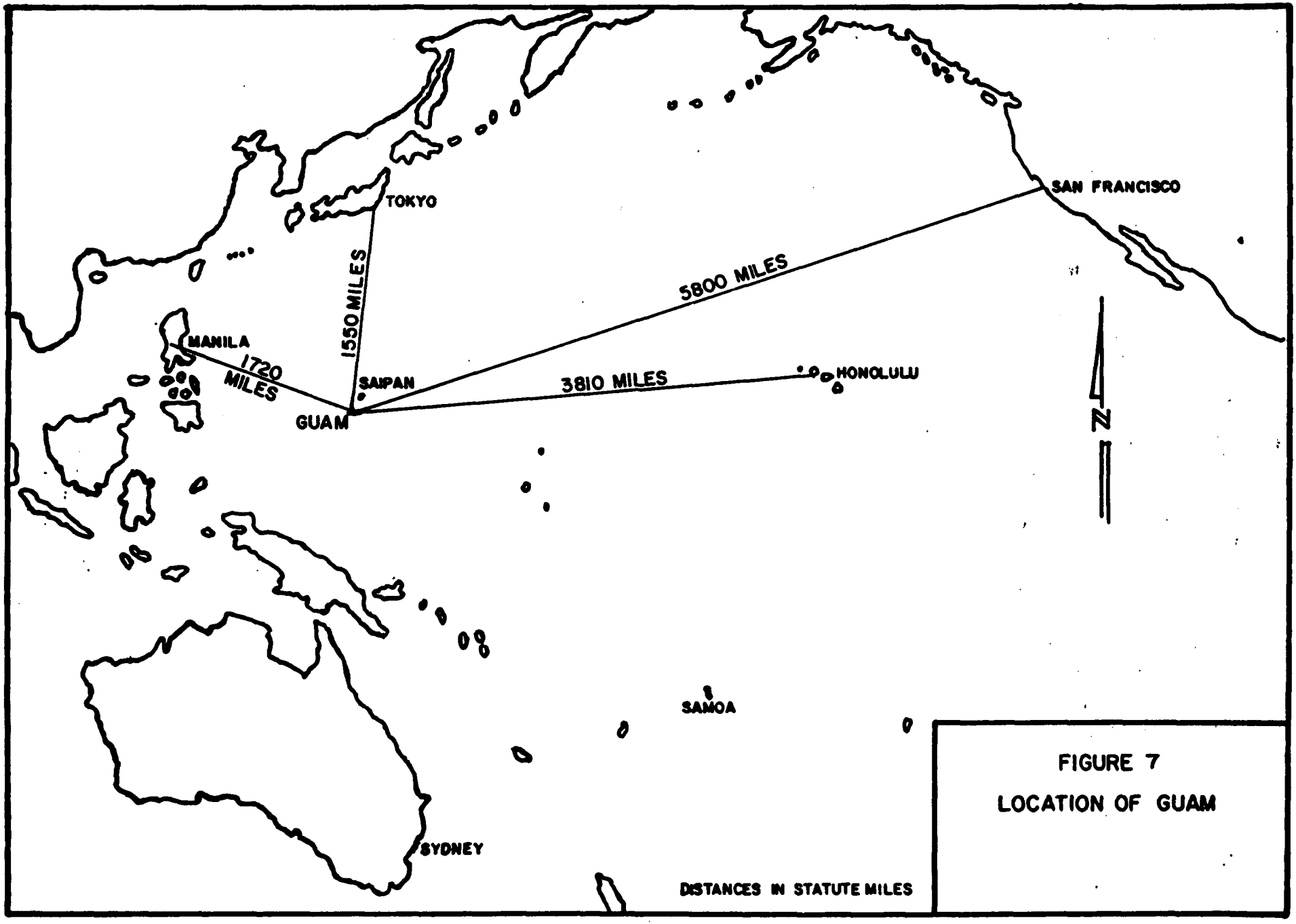


FIGURE 7
LOCATION OF GUAM

Congressional mandate in 1985 requires Andersen Air Force Base to remove the debris from the private property. This environmental impact statement is the first phase in response to the mandate.

B. PHYSICAL ENVIRONMENT

1. *Physiography.* The islands of the Marianas archipelago are high points of submarine ridges of volcanic origin. Guam is composed of two distinct geologic areas. The northern part of the island is a high coralline limestone plateau bordered by the steep cliffs rising about 850 feet. The northern area contains the groundwater aquifer. The southern area is mountainous with broad, relatively impervious areas of volcanic rock. Several mountain peaks exceed 1,000 feet in height.

The northern plateau is bordered by patches of coastal lowland and valley floor. The plateau consists of essentially of a single broad plateau surface bordered by steep coastal cliffs. The surface of the plateau includes scarps, mounds, sinkholes, cliff summit ramparts, elongated swales and coastal terraces. Elevations in the plateau land range from sea level to 560 feet at Uruno Point. The area is within a slide and erosion zone as depicted in the Bureau of Planning report, Guam's Natural and Man-Made Constraints. There are no streams in the plateau land; drainage is downward by percolation into the porous limestone.

2. Geology. The geological history of Guam began with the building of a submarine volcano on the north-south Marianas rift with the first extrusions chiefly basaltic pillow lavas from fissures a few feet wide. The fissured zone served as a dike complex. An intermittent explosive phase followed during which more than 1,000 feet of andesitic tuff and agglomerate with interstratified shales and marls containing Miocene foraminifera was laid down. The volcanism period was followed by intense folding and overthrust faulting, deposition of shallow-water limestone and renewed faulting. Eventually there was an emergence of 1,300 plus feet extrusions and subaerial erosion. During the Pleistocene period, the extrusions were resubmerged to 700 feet above the present strand, which three islands surrounded by coral reefs existed. The Barrigada limestone contained deposits of great quantities of reef talus which forms the northern plateau. This period was followed by a complicated series of emergence and submergence.

Generally, Guam is delineated into four geological units (Stearns, 1947) which are lava flows and associated dikes; explosive volcanic rocks; limestone; and alluvium. The lava flows and associated dikes are chiefly composed of pillow lava poured from vents beneath the sea. Explosive volcanic rocks consist of fine-grained hardened ash, ashy marine sediments, indurated ash with volcanic fragments and angular and subangluar rock fragments regaining from several inches to several feet across which probably resulted from submarine volcanic explosions. The explosive volcanic rocks and associated sediments form most of the south half of the island and overlie the lava.

Limestone deposits comprise several varieties of different ages, origins and degrees of purity. The most dominant variety is massive emerged reef limestone consisting of coral, coralline algae, shells, calcite and dolomite.

The alluvium, detritus deposited by streams, occurs as narrow bands along rivers and as flats near the shore. The alluvium is dark brown, loosely consolidated and consists of fine silts, sand and gravel from volcanic rock. Much of the alluvium along the coast appears to be delta deposits formed when the sea was five feet higher than present.

The project site consists of Mariana limestone (reef and detrital) of Tertiary and Quaternary age and Quaternary beach deposits. Mariana reef limestone is massive, generally compact, porous and cavernous white limestone of reef origin especially along cliff faces and made up of mostly corals in a matrix of encrusting calcareous algae. Mariana detrital limestone is friable to well-cemented coarse- to fine-grained generally porous and cavernous white detrital limestone, mainly lagoonal origin.

3. Soils. The soils of the project are can be characterized as surficial soils that were developed on limestone and coastal flats. The soil types found in the area are Guam clay, Shioya soil and limestone rock land. The Guam clay is generally less than 12 inches deep, and the soil-bedrock contact is usually abrupt and irregular. The limestone crops outs in about 10 percent of the area. The soil is well drained and the underlying limestone takes water freely except in times of unusually heavy rains. Shioya soils, allowing rapid percolation to the water table, occupy discontinuous, low coastal terraces 3 to 30 feet above the sea. The seaward portions are subject to erosion and deposition by wave action. The limestone rock land consists of patches of reddish, brownish, shallow granular clay, interspersed among exposures of limestone bedrock, pinnacles, boulders and fragments. Rapid internal drainage occurs through crack, joints and pores of the limestone. During infrequent torrential rains, there is some surface runoff.

4. Climate. The climate of Guam is almost uniformly warm and humid throughout the year. Afternoon temperatures are typically in the wide to high eighties with nighttime temperatures in the low seventies or high sixties. Relative humidity ranges from 65 to 75 percent in the afternoon to 85-100 percent at night. Although temperature and humidity vary only slightly throughout the year, rainfall and wind conditions vary considerably.

Guam has two primary seasons and two secondary seasons. The primary seasons are the four-month dry season extending from January through April. The four-month rainy season extends from mid-July to mid-November. The secondary seasons are May to mid-July and mid-November through December. These are transitional seasons which are either rainy or dry depending upon the nature of that particular year.

The mean annual rainfall on Guam ranges from about 95 inches on the eastern side of the higher mountains to about 80 inches along the western side of the southern half of the island. On the average, about 15 percent of the annual rainfall occurs during the dry season and 55 percent during the rainy season.

The dominant winds on Guam are the trade winds which blow from the east or northeast. The trades are the strongest and most constant during the dry season with winds typically between 15 and 25 miles per hour. During the rainy season, the weather may be dominated by westerly moving storm systems that bring heavy showers, steady rain or torrential rain. Typhoons are moderately common with one or more damaging typhoons striking the island during August to November period. These bring tremendous rains and also violent winds that may cause a surge of water onto low-lying coastal areas. Every three to four years a major typhoon can be expected to cause severe damage. A recent example is the 1975 Typhoon June which sustained winds of 175 miles per hour. Typhoon June passed 200 nautical miles to the west of Guam and caused severe coastal flooding from storm surge and waves. In the following year, Typhoon Pamela struck Guam directly and caused over $500 million in damage.

5. Earthquakes. Guam, living about 70 miles northwest of the deep Mariana Trench, is an active seismic zone. Since 1825, there have been 19 recorded shocks of estimated Rossi-Forel intensity of VI or more and two of an estimated intensity of IX. In 1902, a severe earthquake caused great damage with many landslides in the mountain areas. From World War II, no consistent records were kept until 1956 when the US Navy set up a seismograph station. The U.S. Coast and Geodetic Survey Microseismic Laboratory kept records of seismic shocks for a time from 1951 to 1952. Records from that station indicated that during this period, an average of about two shocks per day were strong enough to be recorded. Of these, about two per month were strong enough to be felt.

6. Tsunamis. Little information is available on tsunami effects. The historical information on tsunamis are as follows:

1849 tsunami -no damage
1952 tsunami -40-50 minute seiche amplitude of less than 1 foot
1964 tsunami -25-30 minute seiche in Apra Harbor

Although no damaging tsunami has been recorded from Guam, a sea wave associated with the earthquake of January 1849 carried a woman walking along the coastal road of Talofofo Bay to sea. The probability of a large tsunami causing considerable; damage appears to be remote; however, most of the low land on the island is protected by coral reef which acts as filter or baffle for long period waves. Open bays unprotected by reef are most likely to be flooded if a tsunamis should strike Guam.

7. Oceanography The Mariana Islands separate the Philippine Sea from the North Pacific Ocean. The ocean surface temperature is about 82

degrees Fahrenheit year around. The north Equatorial Current caused by northeast tradewinds generally flow in a westerly direction with a velocity a 0.5 to 1 knot.

The tides are semi-diurnal with a mean range 1.6 feet and a diurnal range of 2.3 feet. Tidal data for a 19-year period between 1949 were taken at Apra Harbor by the National Oceanic and Atmospheric Administration, National Ocean Survey and are summarized below:

	Feet
Highest Tide (observed)	3.31
Mean Higher High Water, MHHW	2.40
Mean Sea Level, MSL	1.41
Mean Lower Low Water, MLLW	0.00
Lowest Tide (observed)	-1.89

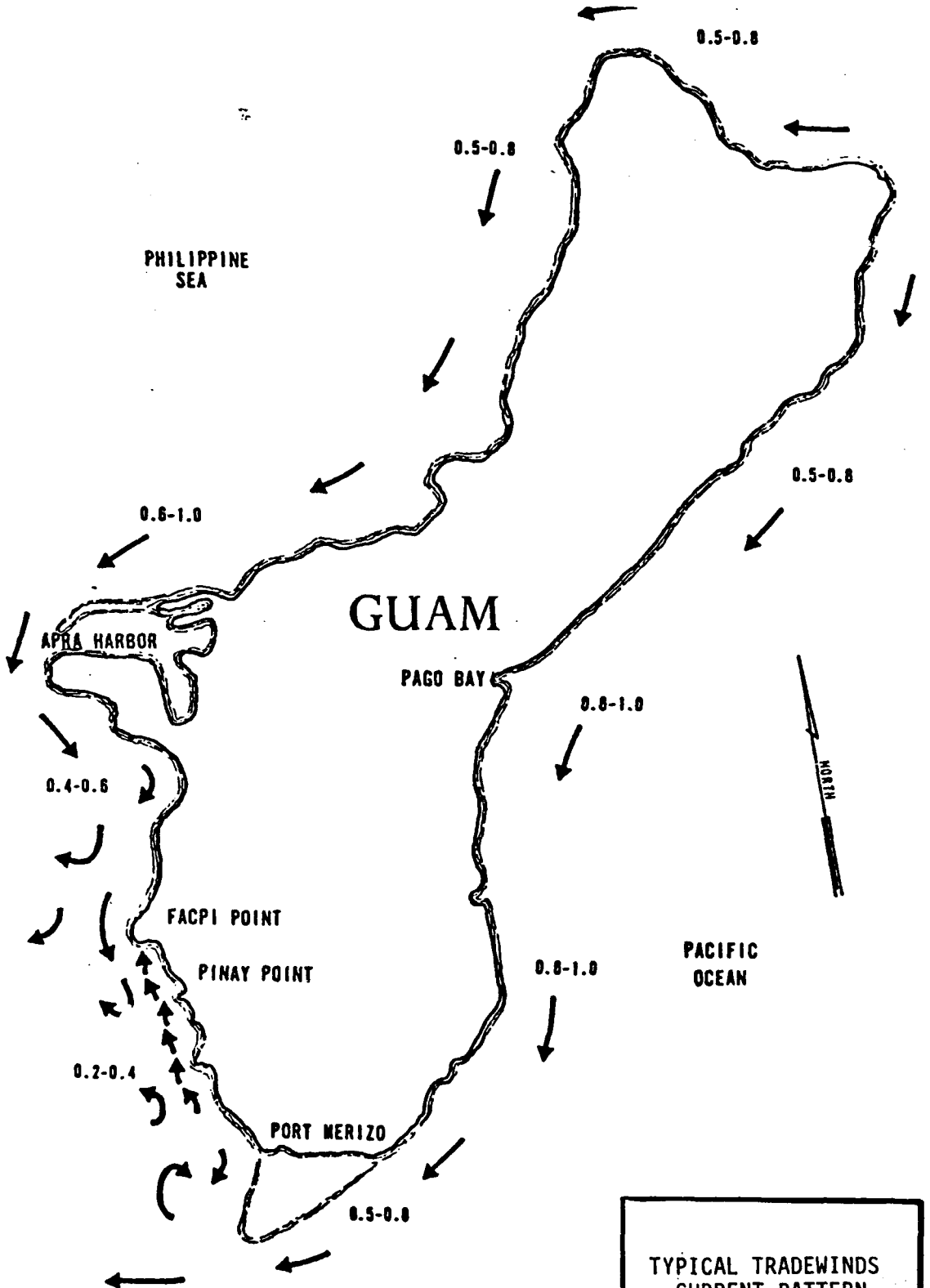
Extreme annual tide predictions approach 3.5 feet on Guam (from 2.6 to -0.9), and occurs during June and December.

The short period wind wave generated by trade winds, dominates Guam wave climate. The wind waves are 7 feet or less about 84 percent of the time. The longer period waves are generated by storm centers (tropical and typhoons) sometimes about 1,000 miles away. The most severe waves are associated with typhoons which strike or approach closely to Guam; wave heights or greater than 8 feet can be expected to about 11 percent of the time in an average year.

8. Currents. The northeast tradewinds of the area play a significant role in generating the North Equatorial Drift Current that sweeps by Guam from east to west. This current, splitting at the northeast corner of the island and flowing along the east and west coast of Guam, is responsible for much of the energy that flows along the coast (Figure 8). As the current stream flows along the west coast, the nearshore portions become distorted and forced into complicated eddy streams by prominent headlands and local submarine topography. These currents may alter their flows due to seasonal changes in strength and direction of the North Equatorial Current. In addition, they are further complicated in some areas by superimposed tidal currents which result in temporary reversal of direction with changes in the tide.

Inside the reef margin, inshore water movement is generated by primarily tide changes and wave action which combine to transport water over the reef margin onto the fringing reef flat zone and often forms longshore currents on reef flats and returned to sea as rip currents through natural low spots or surge channels through the reef margin.

9. Water Quality. The Guam Environmental Protection Agency classifies the marine water of the project area as M-1 (excellent) and surface water as S-2 (medium). The uses to be protected in Category M-1 are conservation of wilderness areas including protection of natural aquatic life, marine scientific research, aesthetic enjoyment and



TYPICAL TRADEWINDS CURRENT PATTERN
FIGURE 8

Source: Draft EIS for Access Easement Across US Air Force Lands to Seibu Leisure (Guam), Inc. for Proposed Development of Lot 10080

recreation. The use shall remain free from pollution attribution to domestic, commercial and industrial discharges, shipping and intensive boating or mariculture, construction and other activities impairing their intended uses. There are also no zones of mixing permitted within this category. Surface waters with Category S-2 are used for recreational purposes including water contact recreation, potable water supply after adequate treatment is provided and propagation and preservation of aquatic wildlife and aesthetic enjoyment.

Since 1978, Guam EPA has established numerous sampling stations. Marine and reef flat stations such as the Double Reef station located at the northern border to the U.S. Naval Communication station Finegayan indicate the water quality is generally within the limits set the the water quality standards except for occasional high nitrate value and low dissolved oxygen. Stations that did exceed nitrate standards were all on the reef flats and mostly affected by surface water discharges. In addition, groundwater from the lens is continually leaking and its average nitrate concentration is 10 times the maximum allowable concentration established for marine waters. Marine stations where water is classified as M-1 were all in violation of existing standards for residue which probably reflects the existing ambient environment and that the standard may be inappropriate. The Double Reef Station indicates that nitrate-nitrogen standards, dissolved oxygen, and phosphorous have been exceeded at one time or another (Appendix B).

10. Hydrology. The groundwater levels are affected by immediate and seasonal recharge, tidal fluctuations and storm waves. Recharge effects may fluctuate groundwater levels to more than a foot. Tidal fluctuations can be measured in hundredths of a foot up to two miles from the shore. Storm-induced fluctuations may approach one foot for short distances inland. As the permeability to the aquifer decreases, the oceanic fluctuations are lessened and the effects in the agrillaceous limestone are small or negligible a short distance inland. Seasonal variations of water level in the aquifer with low permeability can be measured in tens of feet.

In many areas where recharge from the rainfall percolates down through the limestone and is essentially stopped by the less permeable volcanic rock before it reaches the water table, perched water may collect in small bodies if the slope and configuration of the volcanic surfaces are favorable or the contact to a discharge point or until it reaches the water table. The discharge points usually yield fresh water even close to the ocean which indicates that the water does flow along the top of the volcanic rock and has little opportunity to mix with sea water.

The limestone forming northern Guam permits a moderate to high permeability of rainfall to the aquifer that rests on an eroded surface of relatively impermeable volcanic rock. The water table arises from sea level at the shore to several feet above sea level in the interior. Recharge from rainfall moves rapidly downward through the cavernous limestone to the water table, and laterally to the saturated zone.

Recharge is intermittent and fluctuates with rainfall. The discharge at or near the shore fluctuates less because of storage in the aquifer.

Pollutant migration along hydrologic route is possible due to high annual rainfall which may exceed 100 inches per year. The majority of the rainfall on the northern portion of Guam percolates rapidly downward to the water table which is slightly above sea level. The rainfall penetrates 150 to 500 feet of overlying limestone and moves laterally to a point of discharge usually to the ocean, spring or pumped well. Any soluable or miscible pollutant may be transported with the ground water to any of these discharge points. While the travel time of the rainfall from the ground surface to the water table has not been documented, minimum travel time may be a few days and maximum travel time is on the order of a few months. For the more porous, cavitated section of the island, the estimated velocity within the limestone aquifer was on the order of ten feet per day (Navy, 1983). Thus, is can be assume that no area in northern Guam is more than two miles from a discharge point and that pollutant transport by ground water can be rapid.

About 70 percent of the drinking water on Guam comes from groundwater and is pumped from the northern lens. The lens is estimated to have a total average daily recharge of 111.9 million gallons. Because of the high permeability of the limestone plateau, no perennial streams exist on the northern portion of Guam. Drainage occurs generally downward through numerous cracks, crevices, fissures, joints and sinkholes to the water table. The water then moves laterally through the aquifer to points of discharge along the sea shore. In time of heavy rains or prolonged rains, standing water occur in the coastal lowlands.

The NAVCAMS Finegayan area lies directly to project site and can be used to describe the hydrology of the project area. Drainage is generally downward percolation of rainfall into the porous limestone substrata. portions of the project area flows over the cliffs to the coastal terraces below. Approximately 30 inches of rainfall infiltrates to the water table and the has the potential for mixing with or dissolving surface or near surface pollutants and introducing them to the ground water. These pollutants would be generally moved seaward to discharge points. The groundwater gradient of NAVCAMS Finegayaan is saline and therefore unusuable for domestic supply (Navy, 1983). Therefore, the project area is not within a recharge area.

11. Aesthetics. The project site is bordered by a white coral sand beach with several points by rocky limestone outcroppings extending nearly to the sea. Spectacular view planes atop the ridge with virtually unspoiled appearance of steep cliffs, sand beach, varied coastline and shallow water reefs. Trail access down the cliff face is obscured by dense vegetation. No road for vehicular access to the property exists.

12. Air Quality. Overall, the air quality at the project site is generally good except when heavy use of Andersen Air Force Base by military aircraft particularly in the morning hours when smoke and exhaust fumes hover close to the ground by temperature differentials, abnormal conditions may occur.

13. Noise Quality. Man-made noise of the site is virtually nonexistent due to the fact that the project area in uninhabited. The only human activities with a significant impact on ambient noise levels are the aircraft operations at Andersen Air Force Base. Usually aircraft noise is of short duration and infrequent, since the restricted use of the Northwest Field. The site is also outside the Air Installation Compatible Use Zones established by AAFB (see Figure 9).

14. Electronic Emissions. A complex of military communication installations surround the project area. The Air Force satellite tracking station facility on the Northwest Field of AAFB and the Naval Communication Station Finegayan operate highly sensitive radiowave and microwave communications equipment. The highly sensitive nature of the equipment and the close proximity to the proposed project requires that no device can be used on the site which causes interference for frequency bands 225-260 MHz, 399.5-401.5 MHz, 1227-1575 MHz, 2.2-2.3 GHz and 8-16 GHz. Interference is defined as:

a. For MHz frequency bands. The man-made noise shall not exceed atmospheric noise measured at the receiving antenna during low noise periods.

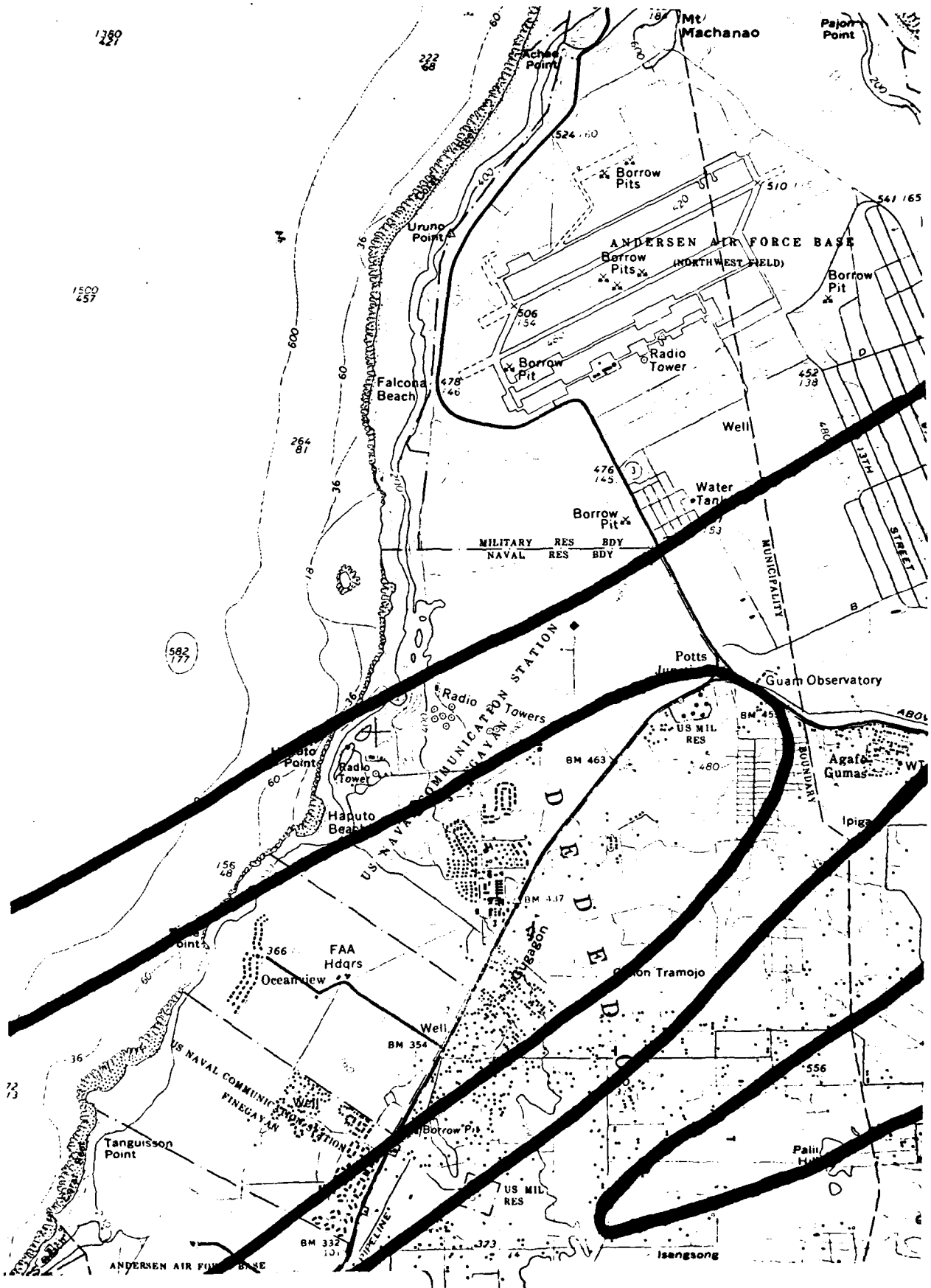
b. For GHz frequency bands. The maximum permissible power flux densities (calculated according to International Telecommunications Union Radio Regulations) are:

(1). 2.2-2.3 GHZ = -154 dbW/m^2
(2). 8.025-11.7 GHz = -150 dbW/m^2
(3). 12.50-12.75 GHz = -148 dbW/m^2
(4). antenna sensitivity = -172 dbm for all bands

These frequency bands are utilized 24 hours per day, 365 days per year. The only use of the project area is when explosives are being transported near the facility. Coordination will be required for the transport of unexploded ordnance or for explosives to be used in order to detonate the unexploded ordnance.

15. Solid Waste. The sanitary landfill at Andersen Air Force Base receives about 16 tons of solid waste per day. The site is located about one mile northeast of the main gate at approximately 13 degrees 34 minutes and 45 seconds north latitude and 144 degrees 53 minutes and 30 seconds east longitude. The landfill occupies about 41 acres and has a projected lifespan of 8 years (Figure 10). Bulky waste, construction debris, etc. are disposed in a hardfill which is in the same vicinity but separate from the landfill. Since the landfill is located on limestone, there is concern for potential leachate contamination of the groundwater. A monitoring well provides data for quarterly reports to indicate whether contamination has occurred. Table 2 gives the groundwater monitoring data for AAFB sanitary landfill.

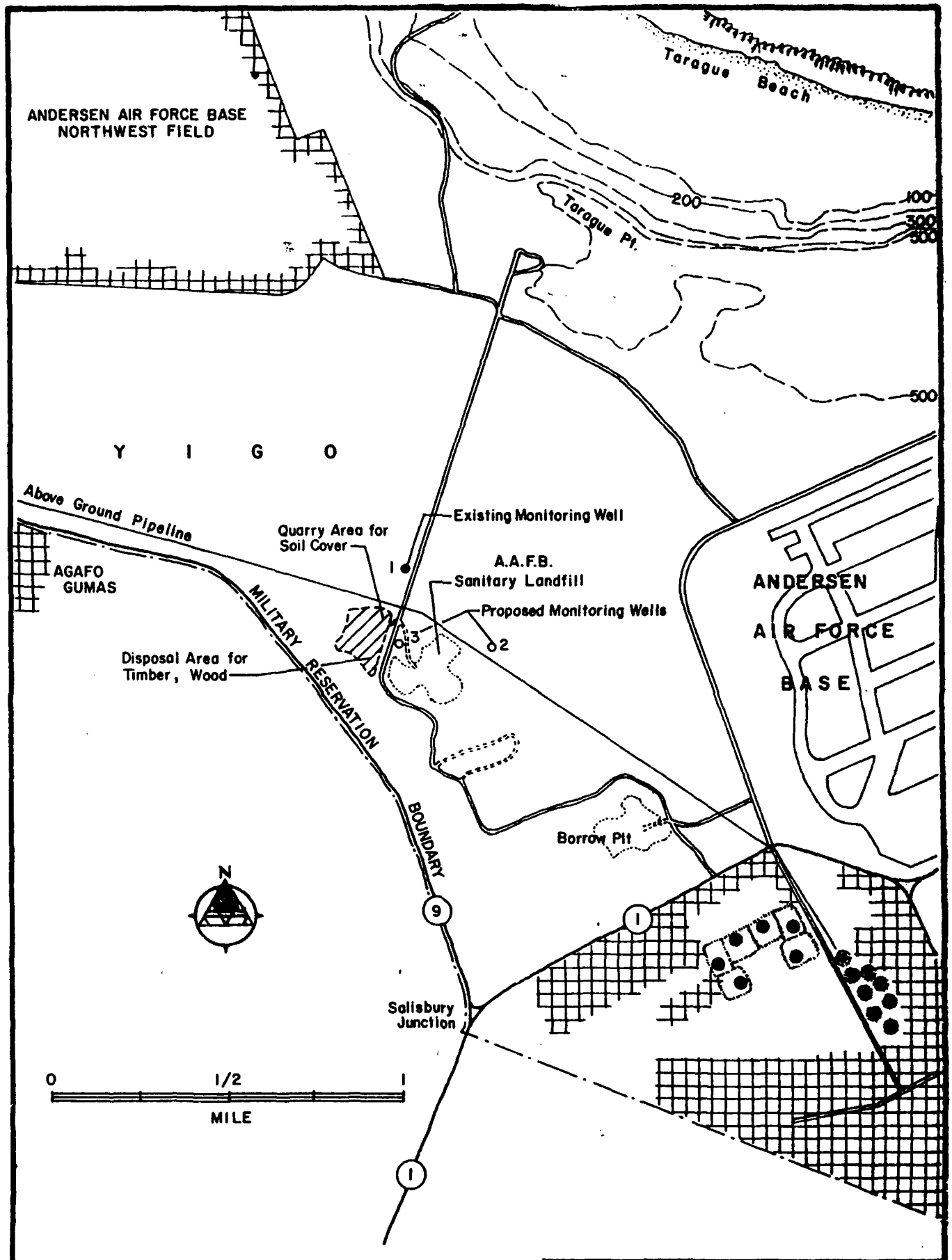
16. Hazardous/Toxic Wastes. In March 1986, the U.S. Environmental Protection Agency conducted a preliminary assessment of suspected hazards



Source: Guam's Natural and Man-Made Constraints

AIR INSTALLATION COMPATIBLE USE ZONE (AICUZ - AAFB)

FIGURE 9



Source: Guam Solid Waste Management Plan

ANDERSEN AIR FORCE BASE
SANITARY LANDFILL
FIGURE 10

TABLE 2.

GROUNDWATER MONITORING DATA
ANDERSEN AIR FORCE BASE SANITARY LANDFILL

MAXIMUM CONTAMINANT LEVEL*		Monitoring Well #1		
PARAMETER	LEVEL (mg/l)	July 1980	August 1979	July 1978
Arsenic	0.05	<0.01	<0.01	<0.01
Barium	1.0	<1.0	<1.0	<1.0
Cadmium	0.01	<0.01	<0.022	<0.01
Chromium	0.05	<0.05	<0.05	<0.05
Lead	0.05	<0.037	<0.054	<0.05
Mercury	0.002	<0.002	<0.002	<0.002
Nitrate	10.0	0.8	0.7	1.1
Selenium	0.01	<0.01	<0.01	<0.01
Silver	0.05	<0.01	<0.01	<0.01
Fluoride	1.4-1.6	<0.1	0.3	<0.1
Endrin	0.0002	NA	NA	<0.001
Lindane	0.004	NA	NA	<0.00002
Methoxychlor	0.1	NA	NA	<0.001
Toxaphene	0.005	NA	NA	<0.0037
2,4-D	0.1	NA	NA	0.006
2,4,5-TD Silvex	0.1	NA	NA	0.004

*SOURCE: Criteria for Classification of Solid Waste Management Facilities

Reference: Guam Solid Waste Management Plan

present with member of the Pacific Strike Team and Technical Assistance Team. EPA reported that 50-80 55-gallon drums were observed of which all were empty and most were rusted out. EPA indicated that empty deteriorated drums or gas cylinders do not constitute an imminent or substantial threat to public health or the environmental. EPA took no further action on this project.

The 55-gallon drums are in such deteriorated condition that the contents no longer remain and have evaporated or leached into the ground. Any contaminants from the drums would quickly migrate to the groundwater table. Since much of the debris has been dumped over the cliff 30 years ago and more, the chances of detecting any contamination would be minimal. The length of time in which the leachate reaches the groundwater table and moved to the ocean is weeks. No monitoring well exists at the site.

17. Missions Requirements. The U.S. Navy is proposing the construction and operation of electronic installations on Tinian, Commonwealth of the Northern Mariana Islands and the Guam. The action in Guam consists of the construction and operation of receiver antenna arrays, ground screens and support facilities at the Naval Communications Area Master Station of the Western Pacific and in Northwest Field, Andersen AFB in northern Guam. The electronic installations are integral parts of the US surveillance network commonly referred to as the Relocatable Over The Horizon Radar. The project area would encompasses approximately 200 acres for each sites. The Navy's project is located directly adjacent to this proposed action. The cleanup action may have direct and indirect impacts to the mission of the Navy's project and consideration on the mission effect will need to be evaluated.

C. BIOLOGICAL ENVIRONMENT

1. Terrestrial Environment.

a. Flora. In March of 1975, Phillip H. Moore conducted a botanical survey of the project for the environmental impact statement for Seibu Leisure (Guam) Inc. Moore divided the native vegetation into four zones and indicated that the zones are fairly uniform within each zone except the forest area which is in a stage of development and can be called a "typhoon forest." Of the many species encountered in the four zones, Moore considered six species which could be considered rare or quite rare on the island. No endangered species were found. A list of the species found in indicated in Appendix C.

On July 15-18, 1986, a walk-through reconnaissance survey was made by Dr. Derral Herbst of the U.S. Fish and Wildlife Service. The project site was divided into three geographical units. The first unit consisted the area between the cliff edge to the vegetation line back to the beach. It is comprised of limestone forest, coconut forest and coastal or strand

vegetation. The dumpsites are mainly in the limestone forest and the edges of the coconut forest. The geographical unit consisted of the flat area or plateau from the edge of the cliff inland to the boundaries of the project site. The vegetation consists chiefly of a mixed native and exotic forest with some areas as road and roadsides, highly disturbed and vegetated mostly with non-native plants. The third unit consisted of the sides and floor of an old borrow pit remaining from the construction of the air base runways. It vegetation consisted of a mixture of native and exotic herbs and shrubs with a few small trees present mostly along its boundaries.

At least 138 species of higher plants were found in the geographical units. Table 3 lists the status of vascular plants within each unit.

TABLE 3. VASCULAR PLANTS IN THE PROJECT SITE

	Status			
	Native		Exotic	
Area	Species present	(%)	Species present	(%)
Cliff edge to beach	70	(74)	25	(26)
Plateau	46	(50)	46	(50)
Borrow pit	22	(56)	17	(44)
All habitats	85	(62)	53	(38)

The coastal or st\ .nd vegetation falls into three subtypes - emerged coral limestone, sandy beach and low swampy coast. Most of the project is is the sandy beach subtype. Principal tree species in this zone include Tournefortia argentia, Cordia subcordata, Guettarda speciosa, Thespesia poppulnea and Cocos nucifera. The grass, Lepturus repens, and the vines, Ipomoea pes-carpae and Canavalia cathartica are dominant herbaceous species. Trimufetta procumbens and other less common species forms the rest of the low, sparse ground cover. Epiphytic species common on trees in this zone include an orchid (Taeniophyllum marianense) and ferns (Pyrrosia lanceolata, Phymatodes scolopendria and Polypodium punctatum).

The limestone forest is one of the most important and extensive vegetation types in the Mariana Islands. The Uruno limestone forest is in a relatively natural state with few exotic species other than Triphasia trifolia which is common and widespread throughout the area. The

vegetative cover at the dump sites consists almost entirely of exotic species and makes the dump sites easily recognizable when viewed offshore. The most common trees of the limestone forest are Pandanus dubius, P. fragrans, Artocarpus altilus, Ficus spp., Aglaia mariannensis, Guamia mariannae, Eugenia reinwardtiana, Premna obtusifolia, Melanolepis multiglandulosa, Macaranga thompsonii, Neisospermum oppositifolia, Morinda citrfolia, Dendrocnide latifolia and Cycas circinalis. The vegetation of the steep cliffs consisted of dwarfed forms of the limestone forest elements but favor certain species such as Mammea odorata and Ficus tinctoria, along with emerged limestone coastal vegetation species such as Bikkia tetrandra and Hedyotis spp.. Within the plateau area where the limestone forest and the disturbed vegetation types interfaces, Annona reticulata and Leucaena leucocphala tend to be more common.

The coconut forest is restricted to the sand flats behind the beach. Bamboo and Alocasia macrorrhiza along the latte stones, grinding stones and the dense coconut trees attest to the long history of use by man. Piper guahamense was a common large herb and saplings of Aglaia mariannensis, Neisopermum oppositifolia, Morinda citrifolia and Cycas circinalis were observed. The trunk of the coconut trees were rich with epiphytes, bryophytes, orchids, and ferns.

The plateau area vegetation consists chiefly of degraded forest of native and exotic trees. The ground cover is comprised of mostly exotic forbes, grasses and shrubs. A few small pockets of native limestone forests are found but they are not common.

Three species of plants are officially recognized by the Territory of Guam as endangered species. They are Cynathea lunata, Serianthes nelsonii and Heritiera longipetiolata.
None of these species were seen on the project site.

Appendix D, Table 2 provides a checklist of the vascular plants of the proposed project site.

b. Fauna. A wildlife survey conducted by Dr. Robert C. Fleischer during July 15-19, 1986 in the project area documented the presence and distribution of endangered native species in the area and the presence of non-native species (Appendix E). The study area occurred atop and along the bluff between Achae Point and Falcona Beach adjacent to the Northwest Field at AAFB. The survey included two sites located in the southern half of the study area and the third at a dump site and 2.1 kilometers north of the second site (Figure 11). Table 4 indicates the common or important species observed during the field survey.

Table 5 indicates the following species known to be found near or in the study area based on literature review. These species have either been documented in the study area but are now extirpated or those which are known to occur but were not observed during the fieldwork.

At one time, nine native forest birds other than the Mariana crow occupied the study area and its surrounding. The observed populations of birds and

FIGURE 11. WILDLIFE SURVEY TRANSECTS

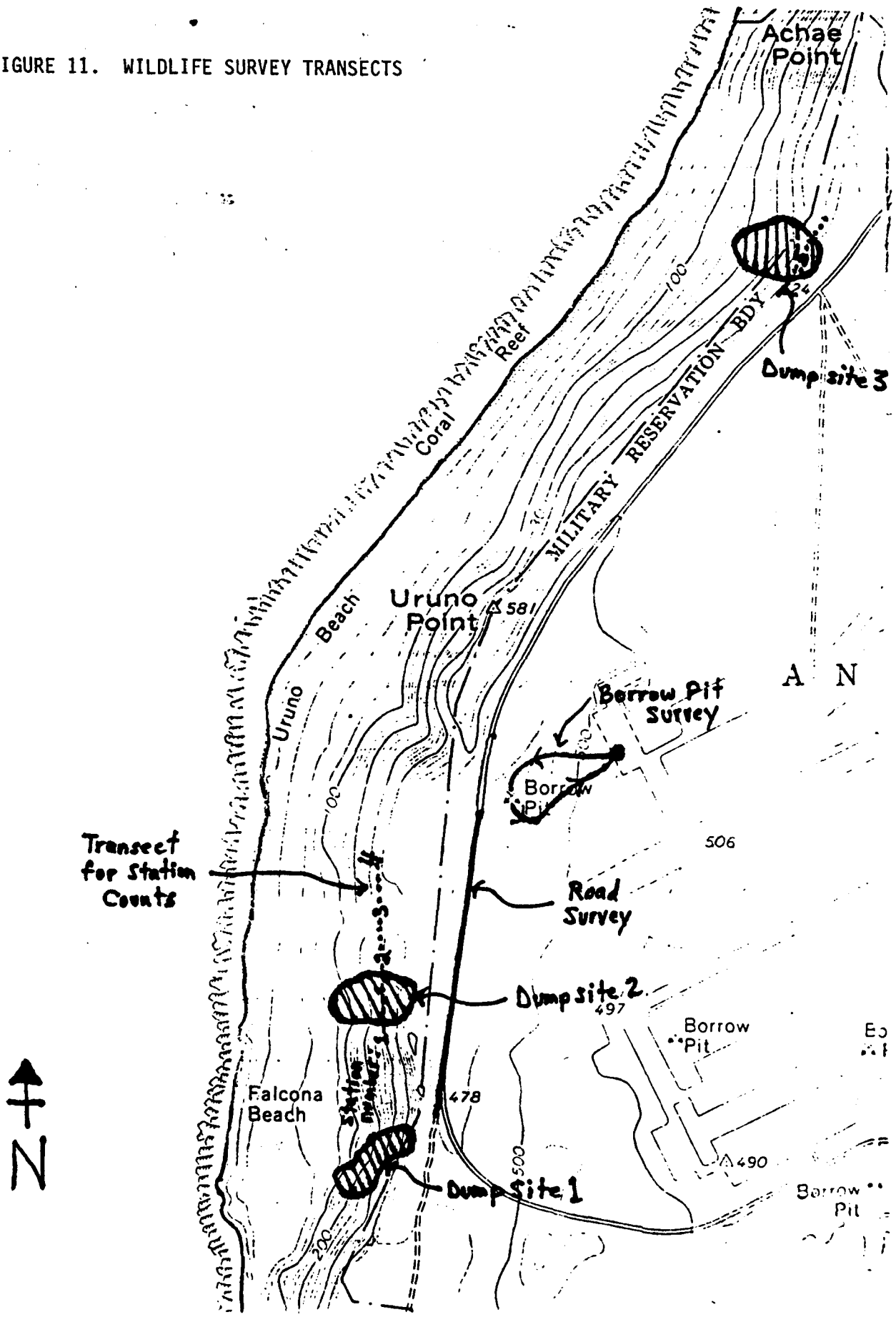


TABLE 4.

WILDLIFE SPECIES OBSERVED DURING JULY 15-19, 1986

BIRDS

Sulfur-crested cockatoo (Cacatua galerita)
Philippine turtle dove (Streptopelia biorquata)
Black drongo (Dicrurus macrocerus)
Mariana crow (Corvus kubaryi)

MAMMALS

Feral pig (Sus scrofa)
Guam deer (Cervus unicolor)

REPTILES

Monitor lizard (Varanus indicus)

INVERTEBRATES (important and common ones only)

African snail (Achatina fulica)
Garden spider (Argiope spp.)

TABLE 5.

WILDLIFE SPECIES DOCUMENTED OR KNOWN
TO BE OR ONCE HAVE BEEN OR NEAR THE STUDY AREA

BIRDS

Guam rail (*Rallus owstoni*)
Micronesian kingfisher (*Halcyon c. cinnamomina*)
*Mariana fruit dove (*Ptilinopus roseicapilla*)
*White-throated ground dove (*Gallicolumba x. xanthonura*)
*Guam broadbill (*Myiagra freycineti*)
*Rufous-fronted fantail (*Rhipidura rufifrons uraniae*)
Micronesian starling (*Aplonis opacus guami*)
*Cardinal honeyeater (*Myzomela cardinalis saffordi*)
*Bridled white-eye (*Zosterops c. conspicillata*)

MAMMALS

Marianas fruit bat (*Pteropus mariannus*)

REPTILES

Brown tree snake (*Boiga irregularis*)

*extirpated on Guam

of some other wildlife species were extremely low in the study area. The rapid decline and eventual extinction of most or all of the species has been most clearly attributed to nest predation and adult mortality caused by the brown tree snake.

The most abundant vertebrates in the study area appeared to be forest dwelling skinks. The spider (genus Argiope) and the skinks have exceptionally high densities which may represent a response to the lack of birds either from predation or from competition.

The only native birds species found during the survey was the endangered Mariana crow. The Mariana crow populations have not declined as rapidly as other species probably due to the adults being too large to be depredated by the snake. The crow, however, is in danger of extinction and efforts to ensure cleanup does not hinder the breeding of the birds during the winter and summer months should be considered.

2. Marine Environment.

a. Physical Characteristics. From Achae Point to just south of Falcona Beach, the beach area is roughly 10-15 meters wide extending from the vegetation line to 30 degrees slope to the ocean. It is composed mostly of unconsolidated bioclastic beach deposit mostly Acropora rubble, mollusks shells, foraminifera and coral sand. The poor developed moat system is shallow between 1-1.5 meters deep. Numerous small freshwater rivulets run from the shore and rocky headlands into the moat. These are noticeable at low tide.

The outer reef flat varying from 50 to 160 meters wide has scattered patches of exposed limestone. In deeper areas, the substrate is covered by staghorn coral, Acropora hebes which forms dense, flat-topped thickets growing upward to the low tide line.

Massive Porites microatolls can be found in deeper pools and area scattered along the reef flat. Large deposits of broken Acropora branches and other coral debris create small patches of sand-rubble substrate.

A general description by Randall and Holloman (1974) of the reef flat and offshore zone is as follows for the project area:

> "A narrow cuesta-type of algal ridge forms an elevated humocky region at the reef margin.... This ridge is solid and massive and is cut by short shallow surge channels. There is no room-and-pillar development at the reef margin and reef front zone comparable to that found on the southeast side of Ritidian Channel. The reef front is cut by a groove-and-spur system along most of the section, although at some locations considerable development of coral-algal knobs and bosses

is taking place on upper surface spurs. The reef front appears to be somewhat in equilibrium as far as outward and erosion are concerned. The 55-foot submarine terrace is present along most of the section, but it is narrow and irregular. At some places there seem to be relic features such as grooves and channels at seaward margin of the terrace which resemble a sunken reef-margin system.

The outer part of the reef front, submarine terrace, and seaward slope zone was heavily infested by Acanthaster planci in 1969 along this entire sector. Most of the reef building corals were killed in all three fringing reef zones as result of predation by these starfish....Wave and surf action prevented intensive starfish damage in the reef margin and inner part of the restricted to this narrow wave-assulted (sic) region at the present time. Recent surveys show that recolonization of the dead corolla surface by calcareous structural integrity of the colonies. New coral growth from planula settlement and small patches which survived the initial starfish predation was also evident in affected zones during this survey."

b. Marine Biology.

(1). Algae. Surveys conducted in April 1975 by Richard E. Dickinson and Roy T. Tsuda list 56 species of marine benthic algae observed in six reef zones at Uruno Point (Appendix F, Table 2). The dominant algae on the inner reef flat are Cladophoropsis membranacea, Jania capillacea and Gelidiella acerosa. The dominant algae on the outer reef are Microdictyon okamurai, Boolea compsita and Polysiphonia sp. Turbinaria ornata is the obvious algae on the reef margin which is predominantly Porolithon onkodes. A golden-colored species of Gelidium is dominant in areas with distinctly raised reef margins.

Large algae such as Halymenia durvillaei, Galaxaura oblongata and G. marginata dominated the reef front. In reef terraces along transects 5 and 6, Tolypiocladia glomerulata is the dominant alga. Halimeda discoidea is distributed sparsely on the reef slope covered with coralline algae.

As a whole, the benthic algae is by far the most dominant and seem to be in ample abundance to serve as food for the herbivorous fish population on the reef terrace.

(2). Corals. The coral surveys were conducted in April 1975 by Dickinson and Tsuda. Appendix F, Table 3 provides a checklist of coral recorded from Uruno Point in 1975. The inner reef flat which is mostly sand is comprised of mostly small branches of Acropora hebes and a

few Porites colonies. The outer reef flat consists of extensive thickets of Acropora hebes and Goniastrea retiformis, Pocillopora damicornis and Psammocora contigua. Flat elevated limestone areas were devoid of coral and were mostly a sand-algal cover.

The reef terrace is sparsely populated with Montipora conicula as the predominant coral and Montipora tuberculosa is also common. Other corals found were Favia pallida, Platygyra rustica, Porites lichen and Pocillopora sp. The reef terrace was heavy affected by Acanthaster planci predation in 1969.

(3). Macroinvertebrates. Appendix F, Table 7 of the Dickinson and Tsuda survey in 1975 lists the Holothurian Holothuria (Halodeima) atra and is also found on the sandy areas. The second most visually dominant holothurian is Stichopus chloronotus which is restricted to solid substrates and is generally more abundant in the outer reef flats. Holothuria (Platyperons) difficilis, however, is the most abundant in the outer reef flat.

Bohadschia bivittata and B. argus are found in the sandy areas in moderate numbers. Actinopyga echinites and Holothuria (Microthele) nobilis were found in moderate numbers.

(4). Marine Turtles and Marine Mammals. Five species of marine turtle are known to occur in the Guam area. The hawksbill turtle (Eretmochelys imbricata) and leatherback turtle (Dermochelys coriacea) have been designated as endangered under both the U.S. Endangered Species Act of 1975 (ESA) and the Trust Territory Endangered Species Act of 1975. The Pacific Ridley sea turtle (Lepidochelys olivacea) and the green sea turtle (Chelonia mydas) have been designated as threatened species under the ESA. The loggerhead turtle (Coretta coretta) known to occur in the vicinity of Palau is an infrequent visitor to Guam. The loggerhead turtle is considered a threatened species. The hawksbill turtle has been seen in the vicinity of Uruno Point area and is believed to be transiting the waters (Stojkovich, 1977). According to the National Marine Fisheries Service, both the green turtle (Chelonia mydas) and the hawksbill turtle (Eretmochelys imbricata) are noted as nesting between Uruno Point and Achae Point (Appendix G).

The five species known to frequent the waters of the Western Pacific are considered endangered and are protected under the ESA and the Marine Mammal Protection Act of 1972. The blue whale (Balaenoptera musculus), Sei whale (B. borealis), finback whale (B. physalis) humpback whale (Megaptera novaengliae) and the sperm whale (Physeter catodon) have a range which includes all of Micronesia. The beaked whale (Ziphius sp.) may also occur in Guam waters; however, it is not listed as endangered but is protected as a marine mammal. Little data exists on the distribution, abundance or population densities in the Marianas and Guam. The humpback whales have been documented off the coast of Saipan and sperm whales have been sighted adjacent to several popular fishing banks offshore Guam.

In 1974, single adult species of the sea cow (Dugong dugon) was discovered in Cocos Lagoon. This single sighting appears to be the only confirmed sighting in Guam in recent times. The sea cow is suspected of migrating from Palau where it is more common. The sea cow is designated endangered under ESA and the Trust Territory Endangered Species Act.

(5). Fishes. The Dickinson and Tsuda survey in 1975 indicated that the reef flat of Uruno Point contains a variety of tropical reef fish - a natural aquarium with approximately 50 species observed. Appendix F, Table 6 lists the fish species recorded from their study.

The U.S. Fish and Wildlife Service conducted a survey of nearshore marine resources of the project area during July 15-18, 1986. A total of 92 species of reef fishes representing 59 genera and 26 families have been recorded within the marine habitats at Uruno Point. The most common families of fishes within the project area are wrasses (Labridae) (15 species), damsel fishes (Pomacentridae)(15 species), butterfly fishes (Chaetodontidae)(11 species), and surgeon fishes (Acanthuridae)(8 species). The most conspicuous fishes includes the damsel fishes Chromis caerulea, Chrysiptera leucopomus, Plectroglyphidodon dickii, P. leucozonus, and Pomachromis guamensis; the wrasse Thalassoma hardwickei; the parrot fishes Scarus gibbus and S. sordidus; and the surgeon fishes Acanthurus guttatus, Ctenochaetus striatus, and Naso lituratus.

It is anticipated that many more fishes than listed may inhabit the project area. A total of 214 species of fishes was recently recorded the the US Fish and Wildlife biologists from five distinct habitat types within the marine unit of the Haputo Ecological Reserve Area, located just south of the project are boundary.

c. Water Movements. Dye studies conducted in April 1975 indicated that during high tide, the water movement was northeasterly and parallel to the shore at all the transects according the Dickinson/Tsuda 1975 report. The movement creates a hazardous swimming condition. At low tide, the dye studies showed considerably less water movement which is caused by minimal drainage when extensive sections of the reef are exposed.

Drogue studies conducted by the Navy Oceanographic Office at 1,3, and 5 miles north of Ritidian Point in 1971 indicated that currents within a mile of Ritidian Point showed a more easterly component during the winter and summer than currents further from shore. Surface currents studies north of Ritidian Point flowed against the prevailing winds and opposite to the North Equatorial Current. Offshore current studies by Dickinson/Tsuda in 1975 indicated a general southwesterly flow except for the morning drogues which moved north from both station on two days. Most of them were affected by wind.

The prevalent southwesterly trend reflects the theory the North Equatorial Current splits northeast of Guam and continues south along the eastern and western sides to converge southwest of Guam. The Navy's study at Ritidian Point seems to contradict this.

3. Endangered Species. The U.S. Fish and Wildlife Service identified three endangered animals found in the project site. They are the Mariana crow (Corvus kubaryi) and the Mariana fruit bat (Pteropus mariannus mariannus). Historically four other endangered species were known to occur in that area but none of the four species would be expected to found there now. They are the Guam Micronesian kingfisher (Halcyon cinnamomina cinnamomina), bridled white-eye (Zosterops conspicillata conspicillata), Guam broadbill (Myiagra freycineti) and Guam rail (Rallus owstoni).

The Mariana crow is similar in appearance and habit to the common crow of North America. Once found throughout the islands of Guam and Rota, it is now confined to the northern part of Guam where the population in 1983 was estimated to be about 150-200 individuals. The reason for the decline of this species on Guam is believed to be predation by the introduced brown tree snake and the decrease of the available native habitat. The crow was listed as endangered on August 27, 1984.

The fruit bat is a relatively large bat with forearms over 5 inches long. The bat is endemic to Guam and several of the Northern Marianas Islands. Although it is listed as endangered only on Guam, it has been recorded on Rota, Tinian, Saipan and Agiguan. Found in the forest habitat of Guam, the bat is now mainly restricted to the cliff line forests in the northern part. The decline of bats is attributed to poaching. The brown tree snake may also be responsible for a significant loss of young bats. The bat was listed as endangered on August 27, 1984 when at that time, the population was estimated to contain about 500 individuals. The numbers are believed to have decreased since then.

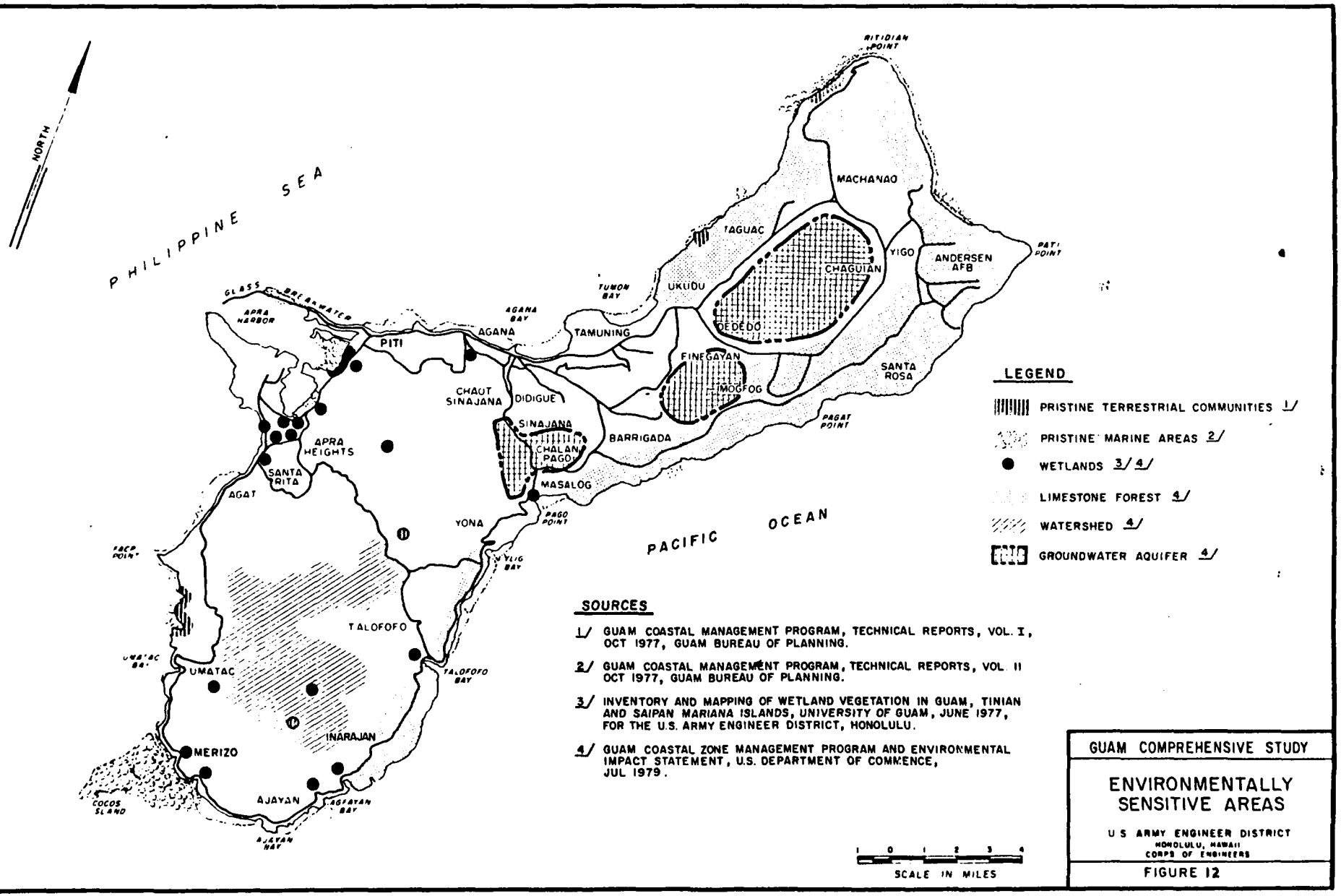
The green sea turtle (Chelonia mydas) and hawksbill turtle (Eretmochelys imbricata) spotted offshore Uruno Point are listed as a threatened species and endangered respectively under the Endangered Species Act.

No endangered plants listed on the Federal or Territorial endangered species lists were found in the project area.

4. Environmental Sensitive Areas.

a. Pristine Communities. In the 1979 the Guam Comprehensive Study by the U.S. Army Corps of Engineers, identified environmentally sensitive areas (Figure 12). The project area is depicted as consisting of pristine terrestrial communities as well as pristine marine areas.

b. Seashore Reserve. All seashore property from 6-10 fathoms landward to the mean high water mark except federal lands on Guam are classified as Seashore Reserve where a special permit is needed for any building. For the Artero property area, however, the seashore area is divided between Navy and Seashore Reserve Commission. The Navy has jurisdiction from the mean high water mark seaward while the Seashore Reserve area begins from the mean high water mark landward.


NORTH
PHILIPPINE SEA
PACIFIC OCEAN
RITIDIAN POINT
MACHANAO
TAGUAC
CHAGUIAN
YIGO
ANDERSEN AFB
PATI POINT
UKUDU
DEDEDO
TUMON BAY
GLASS BREAKWATER
APRA HARBOR
AGANA BAY
AGANA
PITI
TAMUNING
FINEGAYAN
IMOGFOG
SANTA ROSA
CHAOT
SINAJANA
DIDIGUE
SINAJANA
CHALAN PAGO
BARRIGADA
PAGAT POINT
APRA HEIGHTS
SANTA RITA
AGAT
MASALOG
PAGO POINT
YONA
FACP POINT
TALOFOFO
TALOFOFO BAY
UMATAC BAY
UMATAC
INARAJAN
MERIZO
COCOS ISLAND
AJAYAN
AGFAYAN BAY
AJAYAN BAY
LEGEND
PRISTINE TERRESTRIAL COMMUNITIES 1/
PRISTINE MARINE AREAS 2/
WETLANDS 3/ 4/
LIMESTONE FOREST 4/
WATERSHED 4/
GROUNDWATER AQUIFER 4/
SOURCES
1/ GUAM COASTAL MANAGEMENT PROGRAM, TECHNICAL REPORTS, VOL. I, OCT 1977, GUAM BUREAU OF PLANNING.
2/ GUAM COASTAL MANAGEMENT PROGRAM, TECHNICAL REPORTS, VOL II OCT 1977, GUAM BUREAU OF PLANNING.
3/ INVENTORY AND MAPPING OF WETLAND VEGETATION IN GUAM, TINIAN AND SAIPAN MARIANA ISLANDS, UNIVERSITY OF GUAM, JUNE 1977, FOR THE U.S. ARMY ENGINEER DISTRICT, HONOLULU.
4/ GUAM COASTAL ZONE MANAGEMENT PROGRAM AND ENVIRONMENTAL IMPACT STATEMENT, U.S. DEPARTMENT OF COMMENCE, JUL 1979.
0 1 2 3 4
SCALE IN MILES
GUAM COMPREHENSIVE STUDY
ENVIRONMENTALLY SENSITIVE AREAS
U S ARMY ENGINEER DISTRICT
HONOLULU, HAWAII
CORPS OF ENGINEERS
FIGURE 12

D. CULTURAL AND HISTORIC RESOURCES

1. Historic Overview. The history of Guam can be divided into six periods beginning with the Pre-Latte (c. 1500 B.C. to c. 800 A.D.), Latte (c. 800 A.D. to 1521 A.D.), Spanish (1521 to 1898), First American (1898 to 1941), Japanese (1941 to 1944) and Second American (1944 to present).

Based on current archaeological research data, the first inhabitants of Guam were probably settlers from the Philippines-Eastern Indonesian area of Southeast Asia at about 1500 B.C. or earlier. Guam prehistory appears to be broadly characterized by two major cultural episodes, the pre-Latte cultures and Latte cultures. Latte, coral reef slab and/or basalt house support uprights with bowl-shaped capstones, are the most distinctive later prehistoric structural features found at Guamanian sites. They were probably associated with high-status chiefly residences. Although most research on Guam has been associated with the Latte era cultural remains, the pre-latte cultures apparently flourished after initial settlement. Remains from this era, including a well-developed pottery industry, burial grounds and settlements tend to be concentrated along the shoreline and in major stream valleys. During both the pre-Latte and Latte eras, settlement was dispersed over the island, probably organized into small local kinship-based chiefdomships. Alliances between chiefdoms were likely formed so as to allow exchange of resources between coastal and inland areas as well as for warfare. The incidence of warfare appears to have escalated during rapid population increase and expansion into interior portions of Guam during the Latte era, e.g., competition for scarce resources. The economic system was apparently based on the use of sophisticated fishing and marine resource harvesting and hunting technology, horicultural gardening of a variety if tropical cultigens (including possible rice cultivation), exploitation of wild plant resources (mostly spears of Cycadaceae) and to a much lesser degree. hunting of native birds and fruit bat. Population size during most of prehistory, intensive contact was maintained between Guam and the other Mariana Islands. Sporadic, but likely continuous, cultural contact was probably maintained between Guam and the central and southern Philippine Islands.

Ferdinand Magellan, under the Spanish flag, was the first Western explorer to set foot upon Guam in 1521. Spanish colonial presence was not effectively felt on the island until the 1600's. Rapid colonization followed the establishment of a Catholic mission and missionary activities at Agana, a galleon port-of-call at Umatac and the institution of military rule at that time. A protracted and bitterly fought war between the Spanish military and the Chamorro chiefs (direct descendants of the Latte era cultures) during which the Spanish exploited rivalries between chiefdoms by forming alliances with competitors helped to almost totally disrupt the native social systems during the 1600's. This process was exacerbated by calamitous drop in population resulting from the introduction of Western infectious diseases on the island. The almost total destruction of native Chamorro society was assured by the Spanish when after the war all the remaining population was resettled in only a few villages in order to be more closely governed and missionized.

A Chamorro mestizo culture gradually emerged as Guam became an important stop-over on the established galleon trade between Mexico and the Philippines. Its importance increased as a military and colonial center after the independence of Mexico from the Spanish empire in the 1800's. Traditional subsistence patterns were almost totally replaced by introduced ones, including the cultivation of New World cultigens like maize. Spanish rule of Guam ended in 1898 following Spain's defeat in the Spanish-American War. A small American garrison was subsequently established on the island which ruled almost all aspects of civilian life. A U.S. Navy ship coaling station was established at Apra Harbor soon after the colonial transfer of Guam which was used to support American military presence in the Western Pacific Ocean.

The Japanese bombed Apra Harbor on December 8, 1941 and soon invaded Guam and defeated the small American garrison stationed there. Despite the relatively brief Japanese occupation on Guam (until 1944), the impact to Guamanian society was profound and disruptive. As an American reinvasion became more imminent, the Japanese fortified much of the island, destroying many older structures, displacing population and using many Guamanians for corvee labor. Prior to the American invasion and recapture of Guam in July-August 1944, much of the island was heavily damaged by bombing. After 1944, much military dredging and construction was initiated, especially in Apra Harbor area. Many of the razed and leveled villages were reconstructed.

Military presence and development was intensified in the post-World War II era which is reflected in the continuing military control of approximately one-third of the island. The Organic Act of 1950 established civilian rule on the island and a Governor and unicameral legislature were elected. Federal administration control over Guam was passed from the U.S. Navy to the U.S. Department of the Interior. The advent of civilian admininstration opened local markets and greatly stimulated the economic development of modern Guam.

2. Archaeological and Historic Sites. Previously, very little archaeological research has been performed in the northern limestone plateau an bordering beach areas. Hornbostel in 1921-1923 performed perhaps the most intensive research in the area and concentrated on cultural remains at Uruno and Falcona Beaches. A number of prehistoric latte house sites and other remains, including stone-lined wells and mortar stones, were identified and described during his investigation. The other archaeological investigation was performed in the early 1970's during the island-wide site inventory survey for the National Register of Historic Places nominations. Two sites were identified that consisted of the Uruno Complex (66-08-0010) and the Uruno Beach Complex (66-08-0011) (Figure 13).

Archaeological investigations were performed at the project site on July 16-18, 1986. The site includes two prehistoric archaeological sites listed on the National Register of Historic Places and are identified as Sites 66-08-0010 and 66-08-0011. Field investigations were performed by archaeologist, Charles F. Streck. Jr., U.S. Army Corps of Engineers; John Salas, Fabiola Calkins, and Lynda Aguon from the Guam Territorial

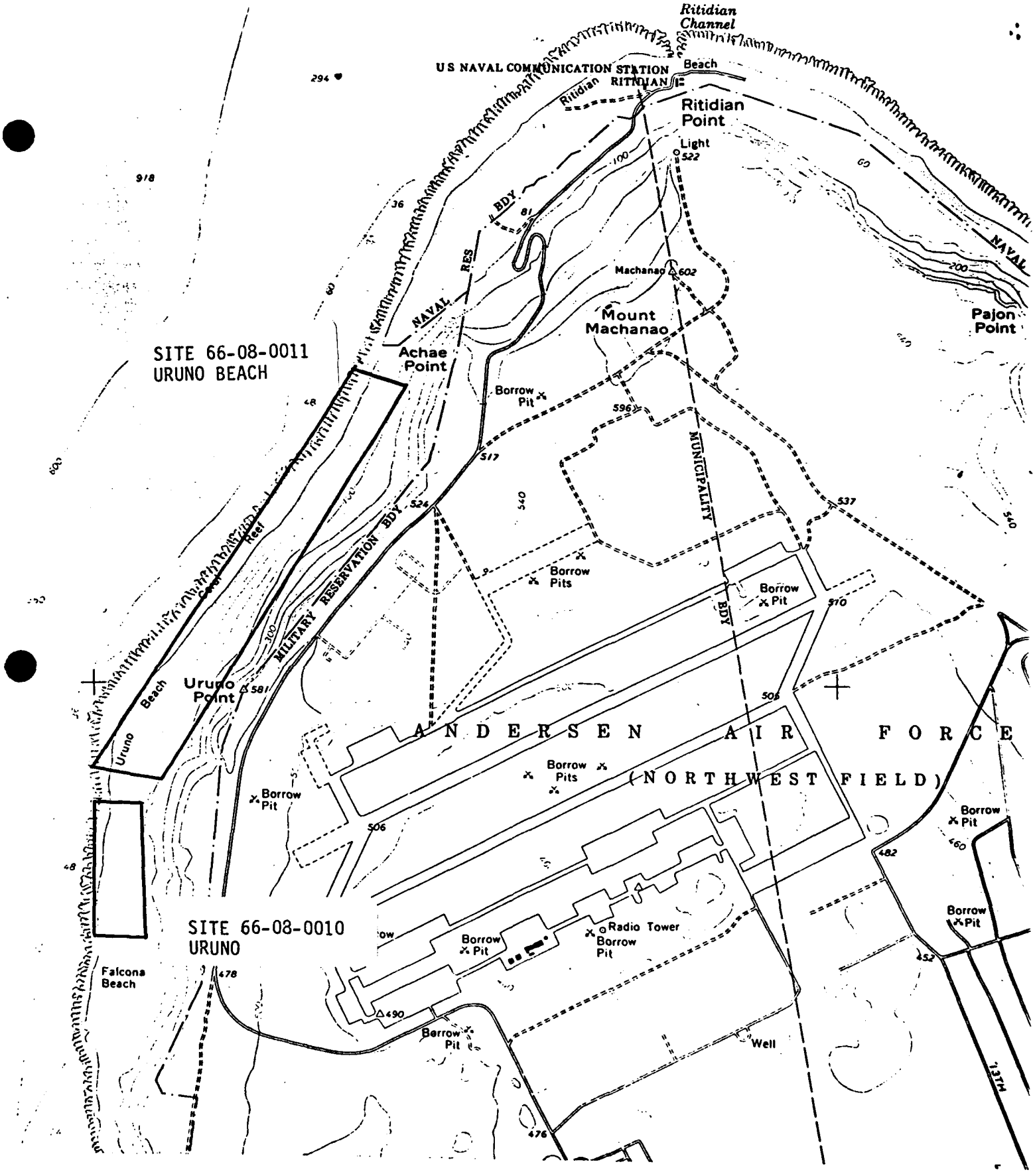


Figure 13. Approximate boundaries of National Register of Historic Places sites at Uruno Point. NOTE: boundaries are only approximate and have not been determined through intensive archaeological survey.

Archaeology Laboratory. A non-intensive, walk-through reconnaissance survey was performed in order to verify the presence of archaeological sites and to assess any impacts which may have affected them subsequent to the their nomination to the the National Register of Historic Places in 1974. Archaeological survey was performed along the upper surface of the limestone cliff adjacent to Andersen Air Force Base, along the lower elevation ledges of the cliff and along the entire Uruno Beach.

The survey found that the variety and density of the cultural remains identified along the lower slope terraces and along the coastal beach strand at Uruno was much greater than expected or implied through the previous archaeological investigations. It is highly doubtful that if very many prehistoric coastal archaeological sites remain on Guam in such a high state of preservation. The limited access to the property and relative geographic isolation has preserved these remains from many modern disruptive activities. The research potential and historic preservation is highly significance.

Surface cultural material is most dense immediately downslope from Dump Sites 1 and 2. These consists of dense scatters of potsherds, marine shell and fish midden, charcoal chunks and blackened sands, amorphous linear alignments of limestone cobbles and coral chunks, at least two rectangular structural alignments, raised earthen areas containing particularly dense cultural material and other cultural remains. The size of the potsherds on the surface is one indicator of the excellent state of preservation of this site and are large than any previously encountered at prehistoric Guamian archaeological sites. Appendix H details the survey and its findings.

The U.S. Navy contracted Hiro Kurashina and Thomas McGrath of the Micronesian Area Research Center to conduct a survey for their project on the installation of electronic receivers. An archaeological survey was conducted in the months of September - December 1986 in the vicintiy of Northwest Field on Andersen Air Force Base and the adjacent Naval Communication Station, Finegayan. The study encompassed 4 separate areas on the interior northern limestone plateau. A total of 17 archaeological sites were encountered during the field survey. Generally the sites are characterized by the presence of sparse surface scatters of pottery fragments in limited areas.

E. SOCIOECONOMIC ENVIRONMENT

Guam is America's westernmost outpost with its strategic significance making it an important base for defensive military activities in the Far East. Since World War II, the islanders have experienced many changes in their social, economic and political life.

1. Economy. Guam experienced a relatively stable year with slow economic growth for 1983, the last year for which data are available. The annual inflation rate of 3.5 percent decreased from 1980-1981. The overall unemployment rate increased from 9.0 to 9.6 percent due to the sluggish economy and the lack of major construction.

Guam's major source of island revenue is federal expenditures. Table 6 illustrated the military expenditures in Guam. Homeporting of the USS Niagra on Guam and additional U.S. Naval vessel activity contributed to the federal spending on Guam. Despite the decrease in military spending in 1983, the Government of Guam received tax revenues in the neighborhood of $19.6 million from the military sector.

In less than twenty years, tourism on Guam has grown to a major industry in the private sectors from 1967 with 6,000 visitors to 1983 with 350,540 visitors. Tourism continues to grow annually at 7.4 percent. The 1984 Guam Annual Economic Review states:

> "Tourism continues to play a key and dominant role in the economy of the island. No effort should be spared by the public or private sectors to encourage the programs and projects needed to develop Guam's tourism industry."

2. Population. The population of Guam continued to grow at a rate of 2.2 percent annually. Since 1980, the population grew from 105,979 to an estimate total of 113,230 persons in 1983. Population density in 1983 was estimated a 542 persons per square mile.

Guam's population lives longer than the population of other developing countries. Females are expected to live to 74 years while males have a life expectancy of 69 or 70 years.

The military accounts for nearly 20 percent of the total island population. Approximately 9,600 are active duty personnel and 10,500 are military dependents. Table 7 indicates a breakdown of the military population.

3. Employment. Guam has had a high level of employment since World War II and had no unemployment problems until recently. Increasing immigration and dependence on relatively cheap imported labor have led to an unemployment situation that is likely to grow more severe in the future. Table 8 provides a breakdown of the workforce in the kinds of employment.

4. Social Environment. The ancient Chamorros were expert seamen and skilled craftsmen who possessed a clan and rigid class system. While it is safe to assume that there are no longer any full-blooded Chamorros in Guam, a strong native strain still exists. Most of the natives who survived the Spanish-Chamorro wars were women who later married Spaniards and other off-islanders. Through them much of the Chamorro heritage and language were passed from generation and preserved.

Since World War II, the Guamanian people have experienced many changes in their customs and way of life. The influx of outsiders brought with them new techniques, new ideas and abundance of cash. Highways were built; electrical power plants were established; and sanitary facilities were installed.

TABLE 6.

MILITARY EXPENDITURES
(Fiscal Year)

Expenditures	1981	1982	1983
Military Pay	$114,012,997	$124,256,000	$169,246,531
Civilian Pay	95,551,527	90,800,000	113,070,488
Military Construction	13,312,287	22,518,000	48,403,500
Petroleum Products Purchases	417,849,295	497,854,000	353,573,000
Other Purchases	30,427,587	26,317,000	27,678,000
Total Spending	$671,153,693	$761,745,000	$711,971,579
Total Withholding Taxes	30,442,649	32,780,000	32,630,675

Source: Commander Naval Forces

Reference: Annual Economic Review and Statistical Abstract Guam 1984

TABLE 7.

MILITARY POPULATION

	JANUARY 1980	JANUARY 1981	JANUARY 1982	JANUARY 1983	JANUARY 1984
ACTIVE DUTY PERSONNEL					
Navy	6,217	6,022	5,823	6,374	6,310
Air Force	3,537	3,671	3,732	3,918	3,967
Army	18	16	59	30	26
Marines	369	353	380	392	468
Coast Guard	126	151	149	121	128
TOTAL	10,267	10,213	10,143	10,835	10,899
DEPENDENTS					
Navy	5,119	6,289	5,671	5,874	5,886
Air Force	4,612	4,919	2,300	2,389	5,594
Army	53	51	158	66	58
Marines	95	83	136	106	170
Coast Guard	120	162	131	119	119
TOTAL	9,999	11,504	8,396	8,554	11,827
GRAND TOTAL	20,266	21,717	18,539	19,389	22,726

Source: Commander Naval Forces Marianas.

Reference: Annual Economic Review and Statistical Abstract Guam 1984.

TABLE 8.

EMPLOYMENT
EMPLOYEES BY INDUSTRY BASED ON PAYROLLS

INDUSTRY DIVISION	MAR 1982	JUNE 1982	SEPT 1982	DEC 1982	MAR 1983	JUNE 1983	SEPT 1983	DEC 1983
All Industries	30,610	30,150	30,880	31,600	31,600	30,870	31,020	31,680
Agriculture	100	120	110	110	100	110	110	140
Construction	1,740	1,560	1,350	1,210	1,240	1,380	1,200	1,410
Manufacturing	1,160	1,170	1,170	1,140	1,160	1,180	1,210	1,280
Transportation	1,560	1,570	1,510	1,520	1,550	1,600	1,570	1,580
Trade	5,480	5,600	5,430	5,560	5,770	5,520	5,660	5,600
Finance, Insurance and Real Estate	1,340	1,370	1,350	1,380	1,390	1,420	1,420	1,410
Services	4,100	4,350	4,400	4,430	4,290	4,270	4,070	4,220
Private Sector	15,480	15,690	15,320	15,340	15,490	15,480	15,240	15,680
Public Sector	15,130	14,460	15,560	16,260	16,110	15,390	15,780	16,000
Federal Government	6,240	6,300	6,050	6,420	6,450	6,530	6,260	6,600
Territorial Government	8,890	8,160	9,510	9,840	9,660	8,860	9,520	9,400

Note: Beginning in 1982, the Current Employment Survey (CES) changed from a monthly to a quarterly basis on Guam. The employment figures reported here are now classified by ownership first, then industry. Government employees previously reported under the Public Administration, Services, and Transportation and Public Utilities are now included in the Public Sector totals. The data included full-time and part-time employees who worked during or received pay for any part of the pay period which included the 12th day of the survey months. The CES survey counts any persons employed by two or more establishments at each place of employment. Proprietors, self-employed, unpaid family workers, domestic servants and military personnel are excluded. Employment figures are rounded to the nearest 10 and some totals therefore do not add exactly.

Source: Current Employment Survey (CES), Bureau of Labor Statistics, Department of Labor, Government of Guam.

Reference: Annual Economic Review and Statistical Abstract Guam 1984.

In recent times, active native movements for establishing Chamorro rights and land reparation have been organized. Precipitated by other movements throughout the country, the native rights movement have gathered interest in many of Guam's projects including the cleanup of this project.

5. Local Government. The Organic Act in 1950 established the framework of Guam's government. Prior to the enactment, the island was administered by the U.S. Department of the Navy. The Organic Act established Guam as an unincorporated territory of the United States and extending all rights and privileges granted in the Constitution except for voting in the Presidential election.

The local government mirrors that of the United States with three branches, namely the Executive, Legislative and Judicial Branches. It is responsible for all local and federal laws relating to Guam. In 1970, the people of Guam were first allowed to elect their own governor. The governors prior to that time were appointed by the President.

Guam has a unicameral legislature consisting of 21 senators serving two year terms and representing 73 precincts within 19 villages. Guam also has an elected Congressional representative to the U.S. House of Representatives; however, the representative does not have the right to vote on the floor.

In 1983, the Government of Guam employed 9,400 persons which constitutes about 29.7 percent of the civilian labor force. Higher pay, subsidized health benefits and retirement make public employment attractive.

In the fiscal year of 1983, the government operating revenues were $161.0 million. Guam's income tax system established by the Organic Act mandates that federal taxes collected from federal employees on Guam including military be reverted to the Government of Guam General Fund. Of the current operating programs, public education, protection of life and property and subsidies to autonomous agencies account for the largest expenditures.

6. Land Ownership. There are three basic categories of land ownership on Guam. They are 45 percent private, 22 percent Government of Guam and 33 percent military land use. The military is the single largest land user on Guam.

When land was under naval rule, much of the land was acquired from private owners by purchase, condemnation or cession. The existence of local government brought about the transfer of thousands of acres of public land previously administered by naval forces.

7. Land Use. The present pattern of land ownership of Guam was derived from historical happenstance and has not resulted from thoughtful planning. For instance, the U.S. Navy controls large portions of land in southern Guam which is better suited for disposal of oil waste because of the impermeability of the volcanic soils compared to porous limestone land

in northern Guam. The project site has been recently rezoned to "H", Resort-Hotel on January 5, 1987 with the passage of the Substitute Bill No. 426.

V. ENVIRONMENTAL CONSEQUENCES

A. PHYSICAL ENVIRONMENT

The real estate alternative would not have any adverse effects to the physical environment. The action involves mostly administrative activities. Cleanup of the property would not be required once the property becomes the U.S. Government because Congress requires that cleanup of the property would be to the owners satisfaction. In this case, the owners would be the U.S. Government. As a result, the beneficial impact on this alternative is that there would be less disturbance to the environment. The lack of cleanup activities would eliminate any further destruction to the pristine limestone forest, endangered Mariana crow and archaeological sites. The real estate acquisition would also have the additional benefit of providing the U.S. Navy and U.S. Air Force with an area which would not be developed and thus has less interference on their communication systems.

The minimal cleanup alternative would remove the tires, large debris items and ordnance from the project area. This alternative would result in some disturbance to the environment; however, the impact is expected to be temporary and would not have a significant effect on the physical environment. Tires would be rolled to designated areas, chained together and airlifted out of the area. Land clearing could be minimized by selecting areas where there is enough open space for the airlift operation. Large items may be cut into manageable sizes for airlifting out of the area. Ordnance remove may require some unexploded ordnance to be detonated in place and create scars in the limestone cliffs and other affected areas.

The cable system alternative would require less clearing of approximately 2 acres of the forest area. Clearing would be needed to place a deadman anchor at the bottom of the cliff and atop the cliff to allow for a crane, a 10-foot high earthen berm and space for sorting the debris material prior to loading onto trucks for disposal. The earthen berm would be removed and reused when the mobile crane is to be moved to the other dump sites. The removal activities may also cause unexploded ordnance to detonate and leave scars on the environment. No roads or staging areas would be required.

The bulldozer alternative would have the most significant effects on the environment. Approximately 14 acres of limestone forest would be cleared in order to construct a staging area and a unpaved temporary access road about 3,000 feet long for the debris removal operation. Removal activities may cause unexploded ordnance to detonate and create scars in the limestone cliffs. The clearing would expose the limestone cliffs to weathering. The access road would be removed after cleanup operations are completed.

The no action alternative has the least environmental impacts to the physical environment. The area is a fragile ecosystem that may be significantly affected by introduction of exotic vegetation and elimination of forest area. Leaving the debris "as is" would create the least disturbance to the pristine limestone forest; however, the no action alternative would not fulfill the Congressional directive of cleanup of the property.

B. BIOLOGICAL ENVIRONMENT

1. Flora. The real estate acquisition and the no action alternatives would not have any impact on the vegetation since no cleanup action is proposed. Minimal cleanup action may increase the chances for exotic introduction of plants. Care must be taken among the persons entering the area to avoid spreading seeds of exotic species into the pristine limestone forests by washing boots and equipment prior to entering the area. Clothing may be checked to assure that pockets, cuffs and etc. are also free of any seeds or pollen. Ordnance removal activities may also cause areas to be devoid of vegetation if unexploded ordnance is detonated in place. Once the native vegetation is removed from the area, the potential for the plants to be replaced by exotic vegetation increases. The affect on the native vegetation is not expected to be significant, since the dump sites consist of exotic vegetation.

The cable system would affect approximately 2 additional acres of the limestone forest. Although the dump sites are covered primarily with exotic vegetation, there will be probably minor damage to the surrounding limestone and coconut forests. The strand vegetation of the exposed ocean cliff faces should not be impacted. The vegetation of the plateau would be impacted if the debris from the dump sites is removed from the top of the cliff and transported inland. Exotic plants may move into the area where the limestone forest would be disturbed. Care should also be taken to reduce any introduction of exotic plants while implementing this alternative. No endangered plants would be affected.

The bulldozer alternative would have the greatest adverse impact due to the more extensive clearing required. It would disturb approximately 14 acres of forest area for the staging area and the access road. Exotic vegetation would probably revegetate the area. Caution must be exercise to reduce any exotic plant introduction by washing equipment and boots and checking clothing for seeds and pollen. No endangered plants would be affected.

2. Fauna. Relatively few birds were observed during the fieldwork. Since the results are identical to the expectations from past observations and literature, the cleanup activities are not expected to be significant on the fauna. The use of helicopters for the minimal and complete cleanup activities may affect the the Mariana crow, an endangered species. Section 7 consultation with the US Fish and Wildlife Service has been initiated to determine the extent of the impact. To mitigate the impact to the endangered bird, construction activities and the use of the

helicopter may be restricted to the non-breeding season. The real estate acquisition and no action alternative would not have an impact on the fauna since no cleanup activities would occur.

3. Marine Environment. Although the ocean route for disposal has been eliminated from further consideration, it was evaluated and has been summarized. The bulldozer alternative is the only alternative that would cause marine related impacts. Construction of channel and unloading area for waste disposal transport could result in substantial damage to the diverse fringing reef and reef terrace habitat near Uruno Point. Blasting and dredging the reef to create a channel would significantly impact the marine life. Blasting will generate noise, dust and flyrock, smoke and odors, and ground vibration. The impacts will depend upon the amount and kind of explosives used, the water depth over the charges, the geology of the site, and the distance to structures and observers. During dredging activities, an artificial feeding situation will develop as predatory fish move in to exploit food resources displaced, killed, injured, exposed or stirred up.

Construction activities may also damage the integrity of the nearby Haputo Ecological Reserve Area by suspended sediment drift.

Although a site has not been determined if ocean disposal of the debris is chosen, anticipated environmental impacts can be discussed generally. The ocean dump site would be located in deep water and should have lower biological activity than the shallower coastal water. It should not be a significant commercial fishing ground. The water depth and coastal currents would should provide significant dilution and dispersion of the dredged material and debris. Agitation of the material and debris in the water column may create temporary nutrient increase and a temporary depression in dissolved oxygen concentrations. Short-term biostimulation may occur, together with mounding and faunal shift on the bottom. Suspended sediment load and water turbidity will temporarily increase. Some plankton may be entrapped in the sediment falling through the water column. The material deposited on the bottom will smother some organisms, but repopulation is anticipated. Toxic effects and pollutant accumulation are possible and bioassay and bioaccumulation tests performed prior to disposal would be used to assess the toxic effects of the material on test animals. In accordance with the U.S. Environmental Protection Agency regulations, bioassay and bioaccumulation tests would be required for disposal material consisting of earthen, solid or dredged material. The results would be reviewed and approved by EPA for the ocean dumping activity.

4. Endangered Species. The Mariana crow is listed as an endangered species and may be adversely affected by the proposed project. The birds breed in the winter and spring months and may be sensitive to noise of heavy machinery operating while they are nesting. This adverse impact can be mitigated by limiting the intrusiveness of the machinery involved. For example, the cable system operations would be positioned behind a large earthen berm which could mitigate most of the noise of the crane

operations. On the other hand, it would be very difficult or impossible to mitigate bulldozer noise. The trucks used to transport the debris materials via the access road could be fitted with mufflers to reduce the noise. The use of helicopters to remove the tires and large debris items could be scheduled during the non-breeding season. The real estate acquisition and the no action alternatives would not affect the crow since no cleanup activities would be generated.

The bulldozer alternative requires more habitat loss than the rest of the alternatives under consideration. Approximately 27 acres of the crow's habitat (13 acres of Dump Sites 1, 2, and 3 and 14 acres of the staging and access road) would be destroyed while the cable system would affect approximately 15 acres (13 acres of Dump Sites 1, 2 and 3 and 2 acres of the construction area) of the habitat.

The Mariana fruit bat, Guam Micronesian kingfisher, bridled white-eye, Guam broadbill and the Guam rail were also identified by the US Fish and Wildlife Service as endangered species known to occur in the area. Only the Mariana fruit bat would be expected to be found there. The Guam Aquatic and Wildlife office indicated that the fruit bat habitat does not inhabit the area (pers. comm.). Consultation under the Endangered Species Act with the U.S. Fish and Wildlife Service has been initiated.

C. WATER QUALITY

The proposed alternatives are not anticipated to have any adverse impacts to the water quality environment, since the alternatives do not consider an ocean route for disposal of the debris.

D. AIR QUALITY

The proposed alternatives are not expected to affect the air quality. Construction activities for the minimal cleanup and complete cleanup alternatives will generate minor emissions from the helicopter, equipment and trucks transporting the disposal material to the landfill. The construction, use and removal of the access road would generate temporary dust. To control the dust, watering the affected area could control the dust problem.

E. NOISE QUALITY

Minimal cleanup and complete cleanup operation alternatives are operations that will generate noise levels. The operation of the equipment helicopters are the temporary noise sources. Although ambient noise levels have not been quantified, noise generated by the trucks transporting the debris to the landfill appear to be of minor consequence since the military lands through which it passes are largely uninhabited. Helicopter noise would be temporary and is not expected to have a significant impact.

F. SOLID WASTE LANDFILL

As previously mentioned Guam has a shortage of landfill space. The debris is expected to be disposed at Andersen Air Force Base. It is anticipated that approximately 104,000 cubic yards of material will be disposed of plus an additional 6,000 tires of various sizes. This amount of fill material will have an impact of landfill space; however, the landfill at Andersen will be able to handle the debris.

The minimal alternative would require landfill space for tires and large debris items. The amount of large debris items has not been quantified but it is estimated that the landfill at AAFB would be able to accommodate the waste materials.

The cable system alternative for cleanup of Dump Sites 1 and 2 would be approximately 5.45 percent of the landfill's capacity or equivalent to one-half year of the landfill capacity. If Dump Site 3 is added to the project site, it would consist of approximately one percent of the landfill's capacity.

The bulldozer operation would require approximately 48,000, 40,000 and 16,000 cubic yards of material for Dump Sites 1, 2and 3 respectively which is equivalent to approximately 6.45 percent of the landfill space in total.

Although hazardous wastes are not anticipated, sampling for hazardous wastes will be done prior to disposal in a landfill. Ordnance shall be disposed at the ordnance range.

G. ELECTRONIC EMISSIONS

Transportation of explosives during the removal operations may involve a potential hazard. Close coordination will be required to properly shield, encase or house all electromagnetic emission sources that cannot be eliminated.

H. CULTURAL RESOURCES

All of the proposed alternatives for the removal of military debris pose either direct or indirect adverse impact to significant historic properties included on the National Register of Historic Places. Previous archaeological investigations in the Uruno Point area, however, have been nonintensive so the absolute extent, location and characteristics of the sites are only sketchily known. Therefore, an intensive archaeological survey including detailed site mapping, test excavation and data analysis is recommended for areas likely to be affected by any of the alternatives including the entire beach and lower limestone cliff terraces prior to the determination of final planning decisions (siting and design of facilities and operations) for this project. In such a manner, the selection of the

debris removal alternative and project placement can utilize data derived from the archaeological survey so as to minimize adverse impact to the site(s).

The no action and real estate acquisition alternative would not require any archaeological surveys. While the alternative would not have an impact on the archaeological sites, the loss of archaeological information of the area would be a negative benefit since the area is one of the significant archaeological sites found on Guam.

The minimal cleanup alternative is not anticipated to significantly affect archaeological sites since the disturbance to the environment would be minimal. To mitigate any impacts, further studies would be required for compliance with the National Historic Preservation Act.

The cable system alternative would also require further studies to minimize and to mitigate any adverse impacts to the archaeological sites and to comply with Sections 106 and 110 of the National Historic Preservation Act.

The bulldozer debris removal alternative would pose the greatest direct and/or indirect potential adverse impact to historic properties along the beach and lower slopes at Uruno. Therefore, the scope of the intensive archaeological survey performed in fulfillment of agency responsibilities under Sections 106 and 110 of the National Historic Preservation Act of 1966, as amended, can be reduced if the U.S. Air Force decides not to pursue this alternative any further.

I. SOCIOECONOMIC RESOURCES

The proposed project should bring positive economic benefits to Guam in terms of increased federal expenditures and increased tax revenues. No effect on the land use plans is anticipated.

J. MISSION REQUIREMENTS

The project area is located near communication systems. In addition, the U.S. Navy is proposing a new receiver station in the near future. While it is not essential, the less development within this area would have a positive beneficial impact to the mission of the U.S. Air Force and the U.S. Navy. The real estate acquisition alternative could assure that development within the area is minimized since it would be in the control of the U.S. Government.

The minimal cleanup and complete cleanup alternatives would provide increase the potential development of the property. In January 1986, the outgoing Governor Bordallo signed into law a bill that rezones the area to hotel/resort; thus, providing the way for development of the property.

Coupled with the cleanup action, the potential of the project area to be developed is increased. Extensive development of the area could adversely affect the communications systems and their missions.

K. POTENTIAL DEVELOPMENT

As previously stated, the project area has been rezoned to hotel/resort. The area, however, does not have utilities and would require water, sewage and utilities lines to be transmitted to the property in order for any development to occur. While none of the alternatives would limit the development the project area, the minimal and complete cleanup alternatives would enhance the project area to make it more feasible to development. With the potential hazards eliminated, the development of the area could be encouraged.

L. REGULATIONS

The proposed action will require compliance with the Section 106 and 110 of the National Historic Preservation Act, Section 7 consultation under the Endangered Species Act, compliance with the Resource Conservation and Recovery Act and determination that the project is consistent with the coastal zone policies under the Coastal Zone Management Act.

K. TIMING OF PROJECT

The rainy season in Guam occurs during mid-July through mid-November. The dry season extends from January to April. The breeding season of the Mariana crow is the spring through the summer. As a result, the timing of the project could be limited to approximately four months which is not enough time to accomplish the cable system or bulldozer alternatives. These alternatives could require construction activities during the rainy season and/or during the breeding season of the crow. The no action and real estate acquisition alternatives would not be affected. The minimal cleanup alternative may not be affected by the limited amount of time.

L. LIST OF MITIGATION MEASURES

The following is a list of major mitigation measures identified during in this environmental impact statement for each alternative.

1. No Action. The no action alternative will not require any mitigation measures.

2. Real Estate Acquisition. This alternative will not require any mitigation measures since no construction activity is being proposed.

3. Minimal Cleanup.

a. Land clearing action for tire pickup by helicopter should be minimized by using as much of the open space area as possible.

b. Personnel entering the limestone forest areas should assure that their boots, clothing and equipment are free of exotic seeds and pollen by washing down equipment and boots and checking cuffs, pockets, backpacks and other means of possible introduction.

c. Consultation with the U.S. Fish Wildlife Service under Section 7 of the Endangered Species Act has been initiated to reduce any impacts to the Mariana crow.

d. The use of helicopters to remove tires and large debris items should be scheduled during the non-breeding season of the Mariana crow, thereby reducing the impact on the crow.

e. Ordnance removal could also be scheduled during the non-breeding season to reduce the impact on the Mariana crow.

f. Ordnance shall be deposed at the Andersen Air Force Base ordnance range.

g. Further archaeological studies will be conducted to mitigate any impact on the archaeological sites.

4. Cable System.

a. Caution should be exercised to minimize the introduction of exotic vegetation such as washing equipment and boots and checking clothing for seeds and pollen.

b. The use of helicopters to remove tires and large debris items should be limited to the non-breeding season of the Mariana crow. Section 7 consultation under the Endangered Species Act has been initiated.

c. Ordnance removal should be limited to the non-breeding season of the endangered Mariana crow.

d. The crane would be situated behind an earthen berm to reduce noise levels and provide protection for the crane operator and other personnel from any explosion hazards.

e. Sampling for hazardous waste would be required prior to any disposal in a landfill. Ordnance shall be disposed at the ordnance range.

f. Further archaeological studies will be required to minimize and mitigate any adverse impact to the archaeological sites and to comply with Sections 106 and 110 of the National Historic Preservation Act.

5. Bulldozer Operation.

a. Caution should be exercise to minimize the introduction of exotic vegetation by washing equipment and boots and checking clothing for possible seeds and pollen.

b. Helicopters and ordnance clearance activities should be done during the non-breeding season of the endangered Mariana crow to minimize the impact. Section 7 consultation under the Endangered Species Act has been initiated with the U.S. Fish and Wildlife Service.

c. Heavy equipment should be used mufflers to reduce noise levels.

d. To control dust, watering should be used during construction, use and removal of the temporary road.

e. Sampling for hazardous wastes will be conducted prior to disposal in a landfill. Ordnance will be disposed at the ordnance range at Andersen Air Force Base.

f. Intensive archaeological survey will be required in order to fulfill Sections 106 and 110 of the National Historic Preservation Act.

TABLE 9. COMPARISON OF ALTERNATIVES

RESOURCES	DO NOTHING	REAL ESTATE ACQUSITION	ORDNANCE ONLY CLEANUP	ORDNANCE/LARGE ITEMS CLEANUP	CABLE SYSTEM	BULLDOZER
ENV'L IMPACTS						
Exotic Plants	No impact	No impact	Minimal	Minimal	11 acres affected	11 acres affected
Limestone Forest	No impact	No impact	No impact	No impact	Major impact; 15 acres of Sites 1,2,3 affected	Significant; 27 acres of Sites 1,2,3 affected
Noise	No impact	No impact	Helicopter noise	Helicopter noise	Equipment noise	Significant; truck, bulldozer noise
Wildlife	No impact	No impact	Minor impact	Major impact	Significant impact	impact
Endangered Species	No impact	No impact	Minor impact	Minor impact	Major impact	Significant impact
Cultural	No impact	No impact	Minor impact	Minor impact	Major impact; 3 acres affected	Significant 26 acres affected
Air Quality	No impact	No impact	Negligible impact	Negligible impact	Minor impact	Major impact; exhaust from trucks, bulldozer

TABLE 8. (CONT.)

RESOURCES	DO NOTHING	REAL ESTATE ACQUISITION	ORDNANCE ONLY CLEANUP	ORDNANCE/LARGE ITEMS CLEANUP	CABLE SYSTEM	BULLDOZER
Water	No impact	No impact	No impact	No impact	Minor impact	Potential impact
Safety	No impact	No impact	No impact	No impact	Berm provides protection	No protection; hazardous to personnel
Landfill	No impact	No impact	ordnance disposal range	ordnance & large items	104,000 yd^3 material; about 6.25% of landfill space	104,000 yd^3 material about 6.25% of landfill space
COSTS	No costs	$430,000 to $1,350,000	$380,000	$630,000	$4,027,000 for Sites 1 and 2; $560,000 for Site 3	$5,299,000 for Sites 1 and 2; $560,00 for Site 3

VI. FINDINGS

This environmental impact statement has addressed the potential environmental impacts of the cleanup of debris on privately owned property adjacent to Andersen AFB, Guam. The focus of the EIS was on the environmental impacts of the various methods of debris removal and cleanup actions on the pristine native limestone forest, archaeological sites and the endangered Mariana crow. Other issues consisted of land use, local economy, safety, noise quality, landfill space, hazardous wastes, and mission requirements.

The no action alternative and the real estate acquisition alternatives are environmentally sound alternatives. While the no action alternative does not meet the Congressional directive to cleanup the property, the real estate acquisition alternative does fulfill the terms of the directive. Therefore, the real estate acquisition is the most environmentally sound alternative and the environmentally preferred alternative since acquisition of the property would eliminate any disturbance to the limestone forest and to any archaeological sites. Restricted access would enhance the preservation of the limestone forest and the habitat of the Mariana crow, reduce the hazards from ordnance and be beneficial to the U.S. Government for existing and future missions. Future development of the site may be incompatible or jeopardize existing military communications and future systems.

The minimal cleanup alternative would be preferable over the cable system because it would have the lesser of environmental impacts; however, this alternative may not fulfill the Congressional directive where cleanup is to the owners satisfaction. This alternative would require minimal destruction to the limestone forest since tires/large debris items would be removed via helicopter. The noise may disturb the endangered bird, however, the impact may be mitigated by avoiding the breeding season. Archaeological sites would be less impacts since removal activities should not adversely affect the sites.

The most environmentally sound method for complete removal of the debris is the cable system. The cable system has less destruction of limestone forest, less impacts to the endangered Mariana crow and less impacts to archaeological sites than the bulldozer alternative. In addition, the cable system reduces the hazards for the construction personnel. The crane operator would be protected by a 10-foot earthen berm from an explosion hazards whereas the bulldozer operator would be unprotected. The operation of a bulldozer attached from a cable and driven down a steep slope is also risky and presents a safety hazard to the bulldozer operator should the cable snap or should the bulldozer tip over.

In conclusion, the recommended alternative would be the real estate acquisition, followed by the minimal cleanup. If complete cleanup activities are required, then the recommended method would be the cable system.

VII. LIST OF PREPARERS

The following persons are primarily responsible for preparing this draft environmental impact statement:

Dr. James E. Maragos, NEPA Coordinator. BS, Zoology; PhD, Oceanography; 2 years postdoctoral research; 8 years environmental consultant; 11 years EIS studies with the US Army Corps of Engineers.

Helene Y. Takemoto, EIS Preparer. AB, Chemistry; MS, Public Health (Environmental Health Management); 3 years research; 9 years EIS studies with State of Hawaii; 4 years EIS studies with the US Army Corps of Engineers.

James Pennaz, Project Engineer. BS, MS,Civil Engineering; 12 years with US Army Corps of Engineers in water resources engineering and planning.

Charles F. Streck, Jr., Archaeologist. BA, MA, PhD candidate (ABD) Anthropology (Archaeology); 13 years research, consulting and government work; 2 years with the US Army Corps of Engineers.

John I. Ford, Aquatic Biologist. BA, MS, Zoology; 3 1/2 years in environmental studies with US Army Corps of Engineers; 5 years in fish and wildlife studies with US Fish and Wildlife Service; 12 years of research in insular liminology.

Dr. Derral Herbst, Botanist. BA, PhD, Botany; 20 years botanical research; 2 years in environmental studies with the US Army Corps of Engineers; 8 years with the US Fish and Wildlife Service as an endangered species botanist.

Dr. Robert Fleischer, Wildlife Biologist. BA, MA, PhD, Ecology; 3 years research assistant; 2 years teaching assistant; 1 year university lecturer; 3 years research;and currently a researcher with the University of Hawaii.

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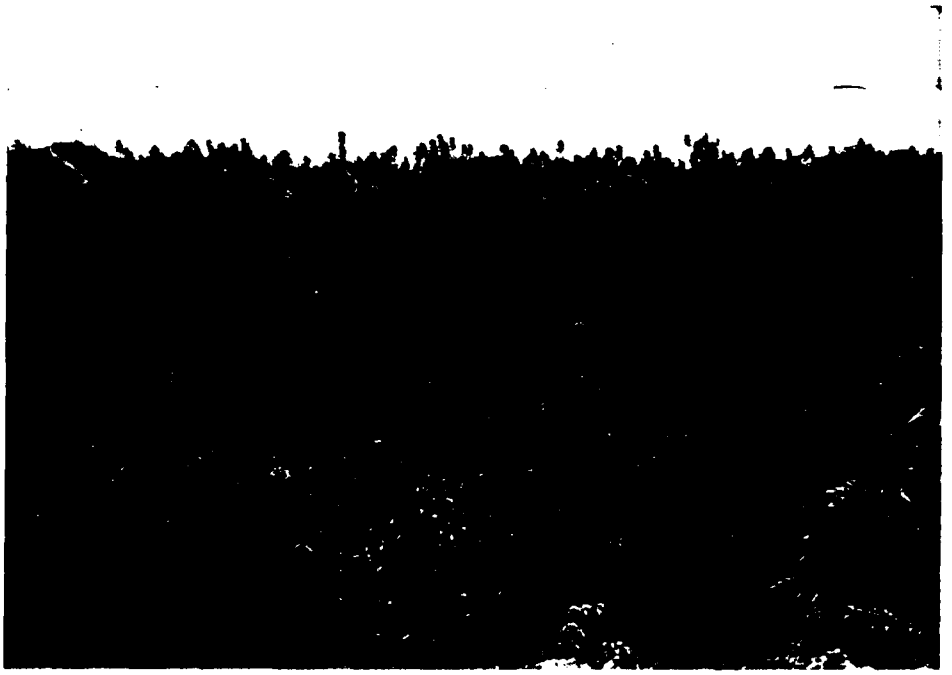
IX. EIS DISTRIBUTION LIST

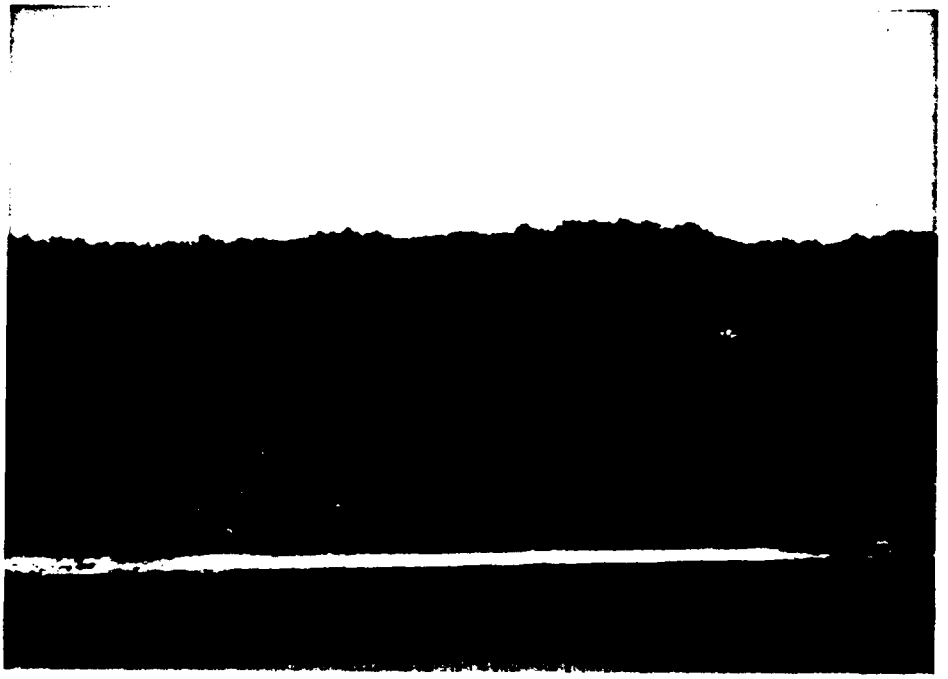
X. PHOTOGRAPHS

Photograph 1. Dumpsite #2 looking from along the upper cliff slopes at Uruno Point.

Photograph 2. Dumpsite #1 looking from near the top of the slope.



Photograph 3. View of the Uruno/Falcona Beach area from atop the cliff.



Photograph 4. Dumpsite #2 as seen from the edge of the coral reef.

Photograph 5. Dumpsite #3 as seen from the edge of the coral reef.

Photograph 6. Dumpsite #1 as seen from the edge of the coral reef.

Photograph 7. Ordnance and rusting metal debris at Dumpsite #1.

Photograph 8. Same as above.

Photograph 9. Deteriorating aircraft debris and other machine parts at Dumpsite #1.

Photograph 10. General scatter of rusting debris along the slope at Dumpsite #1.

APPENDIX A

March 18,1985

Guam Preliminary Assessments

Chris Weden
ERS

Filo

During the period of March 1 thru 8, preliminary assessments of suspected hazards present at several sites on the island of Guam were conducted. Four members of the Pacific Strike Team (PST) and one Technical Assistance Team (TAT) member assisted EPA with these assessments. PST had been on the island one week prior, to conduct training in oil and hazardous materials response.

Three sites were visited March 2 to determine the needs for conducting the assessments.

Ibanez Site

During the construction of a septic tank leachfield, several thousand ampules of calcium hypochlorite were uncovered. Work ceased when many of these ampules were broken open at once by the backhoe operator and chlorine vapors were emitted. Mr. Ibanez indicated that he no longer plans to use the excavated area for a leachfield but did not backfill the hole upon advice from GEPA. We decided the most appropriate thing to do was to remove as many ampules as possible and then Mr. Ibanez could backfill the gaping hole in his back yard. Any one could have done this and since we were there, with nothing better to do on March 4, we did. Approximately one-half drum of ampules were removed, neutralized by reacting with water in a remote area, and the resultant salty broken glass was disposed at the Ordot landfill. I advised Mr. Ibanez that these ampules were used to disinfect drinking water and that there may still be a few buried near the hole but that they did not pose any significant threat.

TAT and PST made a survey of the overall area to determine whether there were any visible signs of other 'hazardous wastes'. Nothing noteworthy was found although one soil sample was taken. There was scattered metal debris that apparently had surfaced after being buried following military occupation.

Fergurur Site

GEPA reported DDT and DDE had been detected on this property after the property owner reported stunting of vegetation. This action was subsequent to a visit to Fergurur's village by the Governor of Guam. Twelve soil samples were taken on March 5, and have been delivered to a laboratory in California for analysis of pesticides and heavy metals. It is speculated that the low levels of DDT and DDE found are probably residual from common spraying 30 or so years ago. TAT recommended heavy metals analysis in addition to a pesticide scan.

Artero Property

GEPA reported approximately 1000 55-gallon drums, numerous compressed gas cylinders, several 200 gallon liquid storage tanks and approximately 200 unexploded bombs, which had been dumped over the edge of a coral cliff sometime since World War II.

Only 50-80 55-gallon drums were observed. All were empty and most were rusted out. One rusted out, empty compressed gas cylinder was observed along with numerous aircraft tires, a cast iron toilet, various pieces of pipe and other debris.

Arrangements with the Navy Explosive Ordinance Dept. (EOD) were made to have one of their experts present during the March 7 survey of this site. Aprroximately 20-30 bombs were observed, most of which were filled with concrete or were empty. There were a few that still contained incindiary material but were in such deteriorated condition that EOD did not consider them a threat. However, because the area was covered with dense vegatation EOD felt that a more thorough investigation was warranted and indicated that they would pursue this activity as soon as the personnel were available.

Other Activities

Gorco Lead Oxide/Sulfide Site: On request of Marvin Young, T-4-2, a survey of the site where lead oxide had reportedly been buried was conducted on March 6. A detailed map of this area is included in the corresponding TAT report. Discussions with Charles Almon of Gorco indicated he thought the material was actually a less soluble lead sulfide. He did not know exactly how much had been buried although he guesstimated 2>x>100 drums. Almon pointed out the general area where a magnetometer survey indicated anomolies approximately three feet deep, suggesting a burial area. Gorco has received a cleanup estimate of $250,000, according to Almon. I advised Almon that drums should at least be removed from the ground and then soil samples should be taken to determine whether additional soil removal and/or groundwater monitoring is required.

Chlorine Cylinder - Saipan: On request of Bill Lopp, IPA to Saipan, two PST went to Saipan on March 7 with necessary protective gear to bleed off chlorine from a full and deteriorated compressed gas cylinder.

Helicopter Overflight: On March 5, Lt. Keane (PST) and I conducted an aerial survey of the Artero Site and the Gorco Site via helicopter courtesy of the Navy's HC-5. Two GEPA also attended. No evidence of any detrimental effects to the environment were observed at the Artero Site.

Conclusions

1. This assessment was conducted at the request of OTP, which was acting on information obtained from GEPA. This information was inaccurate and grossly overstated the hazard potential at the suspected sites. In the future, we will require more stringent documentation by GEPA before committing EPA resources to a site assessment.

2. GEPA could have and should have determined whether any imminent or substantial hazards were present and whether immediate emergency action was required.

3. GEPA management should thoroughly scrutinize field personnel reports on hazardous materials before requesting EPA assistance in the future. Empty deteriorated drums or gas cylinders do not constitute an imminent or substantial threat to public health or the environment, nor does the fact that an area has simply been backfilled over military debris.

4. The training that PST provided GEPA (those who attended the whole session) should enable GEPA to more accurately assess hazardous waste situations.

cc: OTP

APPENDIX B

APPENDIX B

STORET RETRIEVAL DATE 86/08/07 PGM=RET PAGE: 1

DRN
13 35 48.0 144 49 57.0 2
NORTH OF PUGUA POINT NAVCAMSTA
OCEANIA 200100
GUAM

/TYPA/AMBNT/ESTURY

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (M)	00010 WATER TEMP CENT	00300 DO MG/L	31613 FEC COLI M-FCAGAR /100ML	00480 SALINITY PPTH	00630 NO2&NO3 N-TOTAL MG/L	00665 PHOS-TOT MG/L P	00076 TURB TRBIDMTR HACH FTU	00400 PH SU	82245 HORIZON SECCHI METERS	70225 CURRENT SPEED M/SEC
78/03/10	1400	WATER	0	27.5	9.2	0	25.0	.01K			7.80	40.0K	
79/07/12	1030	WATER	0	28.5	5.5	4		.12	.000	.2	7.85	42.8	
79/07/12	1030	WATER	5	28.5	5.8	0		.06	.000	.4	7.80		
81/01/23	1145	WATER	5		6.6	0	34.0	.01	.000	.3	7.92		
81/01/23	1145	WATER	10		6.5	0	34.0	.008	.000	.3	8.00		
81/02/25	1145	WATER	0	28.2	6.9	0	34.0	.01	.000	7.7	7.70		
81/03/31	1230	WATER	0	28.0	5.0	16	34.0	.02	.006	.5	8.28		
81/03/31	1230	WATER	5	27.8	7.1	0	34.0	.04	.003	.6	8.26		
81/05/21	1115	WATER	0	28.9	6.3	0	34.0	.00	.000	.2	7.56	284.0	
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81/07/02	1105	WATER	0	29.5	5.8	0	34.0	.02	.004	.4	8.34		.1
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82/05/27	1105	WATER	0	28.0	6.4	0	35.0	.01	.003		7.95		
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83/03/29	1000	WATER	0	26.5	6.6	0	35.0	.004	.003	.2	8.08		
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84/09/27	1015	WATER	5	29.5	7.5	0	34.0	.009	.004	.3			
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85/04/30	1024	WATER	0	28.2	8.5	0	34.0	.07	.001	.4			
85/09/27	1142	WATER	0	28.9	6.2	0	32.0	.002	.006	.2		40.0L	
85/09/27	1145	WATER	5	28.9	6.1	0	32.0	.06	.000	.2			
85/10/29	0920	WATER	5	29.0	6.0	0	35.0	.00	.033	.5			
85/10/29	0925	WATER	0	29.0	7.1	0	36.0	.00	.036	.2		40.0L	.09
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THAT'S ALL FOLKS
STORET RETRIEVAL DATE 86/08/07
P
RI

APPENDIX C

BOTANICAL SURVEY OF URUNO POINT, GUAM

SUBMITTED TO: AUSTIN, SMITH & ASSOCIATES, INC.
HARMON PLAZA, GUAM

BY: PHILIP H. MOORE

MARCH, 1975

At the request of representatives of Austin, Smith and Associates, Inc., the site of proposed construction at Uruno Point was investigated for evaluation of the plant community (March, 1975). It was discovered that the native vegetation of the area can be divided into four zones (fig. 1) and is fairly uniform within each zone, with the exception of zone 3. The forest is in a stage of development one step short of climax and can thus be called a "typhoon forest" as it is held indefinately in this stage due to major typhoons that occur on the average of about once every 100 years.

Zone 3 may be divided into two segments, the northern two-thirds and the southern one-third or roughly north and south of the main trail from the escarpment to the sea. The southern part is covered by a lateritic clay soil to a depth of several inches and supports a diverse flora dominated by Aglaia, Pandanus ssp., Neiosperma and Cycas. The northern part is rocky with very little soil cover. The dominants here are Triphasia and Cycas with some larger trees here and there. The presence of Triphasia, especially near the first cliffline, indicates a disturbance caused, perhaps, by a recent typhoon. A possible explanation could be that the prominent headland near the southern end of the property protected the southern part while the section north of the headland was exposed to heavy salt spray that killed much of the vegetation that would normally be covering the area.

Of the many species encountered in the four zones, six could be considered rare or quite rare on the island (see attached list) No endangered species were found.

The impact of the proposed construction on the environment would be to destroy a large segment of undisturbed native vegetation and the habitats of several species of birds and mammals. Such destruction could be alleviated somewhat by careful supervision of work and minimal bulldozer activity. The large trees in each zone could be clearly marked for protection before bulldozing is done.

Recommended access to the area would be the existing road through the naval facility (if feasable) rather than the proposed road down the main escarpment. This escarpment should be preserved intact in order to save as much of the native vegetation and wildlife as possible.

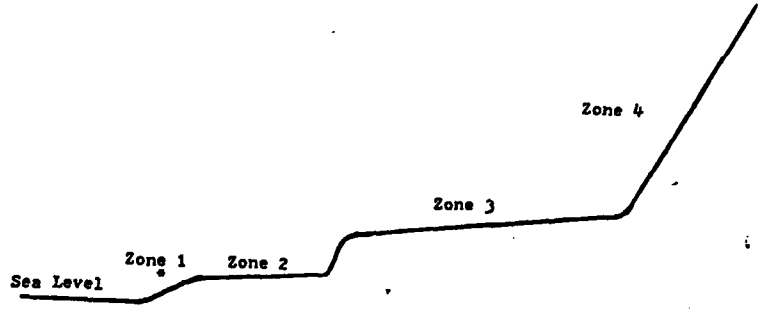

Fig. 1

List of Species (Zone 1)

Barringtonia asiatica
Bikkia mariannensis
Bleekeria mariannensis
Calophyllum inophyllum
Calopogonium mucunoides (vine)
Canavalia maritima (vine)
Casuarina equisetifolia
Colubrina asiatica
Hedyotis foetida
Hibiscus tiliaceus
Mammea odorata
Messerschmidia argentea (dom.)
Mucuna gigantea (vine)
Musa sapientum (planted)
Pemphis acidula
Scaevola taccada (dom.)
Terminalia littoralis
Thespesia populnea

List of Species (Zone 2)

Aglaia mariannensis
Alocasia macrorrhiza (herb)
Artocarpus mariannensis
Bambusa vulgaris
Canavalia maritima
Capparis cordifolia
Carica papaya
Cocos nucifera (dom.)
Cordia subcordata
Cycas circinalis (dom.)
Cynometra ramiflora
Elatostema calcareum (herb)
Eugenia javanica
Eugenia reinwardtiana
Ficus prolixa
Ficus tinctoria
Flagellaria indica
Guamia mariannae
Guettarda speciosa
Hernandia nymphaeifolia (dom.)
Intsia bijuga
Macaranga thompsonii
Mammea odorata
Maytenus thompsonii
Morinda citrifolia
Neiosperma oppositifolia
Pandanus dubius
Pandanus fragrans (dom.)
Piper guahamense
Pisonia grandis
Premna obtusifolia
Psychotria mariana
Randia cochinchinensis
Triphasia trifolia

List of Species (Zone 3)

Aglaia mariannensis (dom.)
Artocarpus mariannensis
Caesalpinia major (vine)
Cordia subcordata
Cycas circinalis (dom.)
Dioscorea esculenta (wild yam)
Eugenia javanica
Eugenia reinwardtiana
Eugenia thompsonii
Ficus prolixa
Ficus tinctoria
Flagellaria indica (vine)
Guamia mariannae
Guettarda speciosa
Hibiscus tiliaceus
Intsia bijuga
Ixora triantha
Jasminum marianum (vine)
Macaranga thompsonii
Maytenus thompsonii
Melanolepis multiglandulosa
Morinda citrifolia
Mucuna gigantea (vine)
Neiosperma oppositifolia (dom.)
Pandanus dubius (dom.)
Pandanus fragrans (dom.)
Piper guahamense
Pisonia grandis
Planchonella obovata
Premna obtusifolia
Taeniophyllum mariannense (leafless orchid)
Triphasia trifolia (dom.)

List of Species (Zone 4)

Aglaia mariannensis (dom.)
Annona reticulata (introduced)
Artocarpus mariannensis
Capsicum frutescens
Carica papaya
Cestrum diurnum (shrub)
Claoxylon marianum
Cordia subcordata (dom.)
Cycas circinalis (dom.)
Cynometra ramiflora
Dischidia puberula (vine)
Discocalyx megacarpa
Elatostema calcareum (herb)
Eugenia javanica
Eugenia reinwardtiana
Eugenia thompsonii
Ficus prolixa
Ficus tinctoria
Flagellaria indica (vine)
Guamia mariannae
Guettarda speciosa
Hernandia nymphaeifolia
Intsia bijuga
Jasminum marianum (vine)
Laportea interrupta (herb)
Macaranga thompsonii
Melanolepis multiglandulosa
Melochia compacta (shrub)
Morinda citrifolia
Neiosperma oppositifolia (dom.)
Pandanus dubius
Pandanus fragrans
Peperomia mariannensis (herb)
Phyllanthus marianus (herb)
Piper guahamense
Pipturus argenteus
Pisonia grandis
Planchonella obovata
Polyscias grandifolia
Premna obtusifolia
Procris pedunculata (herb)
Psychotria mariana
Randia cochinchinensis
Spathoglottis plicata (ground orchid)
Terminalia littoralis

Dominant Plants in each Zone

Zone 1

Messerschmidia argentea
Scaevola taccada

Zone 2

Cycas circinalis
Pandanus fragrans
Hernandia nymphaeifolia
Cocos nucifera

Zone 3

Cycas circinalis
Pandanus fragrans
Aglaia mariannensis
Neiosperma oppositifolia
Triphasia trifolia
Pandanus dubius

Zone 4

Cycas circinalis
Aglaia mariannensis
Neiosperma oppositifolia
Cordia subcordata

In addition to the species mentioned there are numerous herbs, mosses, ferns, lianas and epiphytes as well as native and introduced weeds. Among the most prominent ferns are the following:

Asplenium nidus
Davallia solida
Microsorum punctatum
Phymatodes scolopendria
Pyrrosia adnascens
Thelypteris unita
Vittaria elongata

Rare and Endangered Plants on the Island

Alyxia torresiana	rare
Angiopteris durvilleana	endangered
Barringtonia racemosa	rare (confined to 1 area)
Barringtonia samoensis	rare
Boehmeria tenacissima	rare
Canthium odorata	rare
Cerbera dilatata	rare
Cyathea lunulata	endangered
Discocalyx megacarpa	quite rare
Drypetes sp.	endangered
Eugenia javanica	rare
Eugenia thompsonii	rare
Eurya japonica	rare (if here-not found)
Excoecaria agallocha	quite rare
Fagraea gallilao	rare (confined to 2 locations)
Grewia crenata	rare
Heritiera littoralis	quite rare
Heritiera longipetiolata	endangered
Hernandia ovigera	rare
Ixora triantha	quite rare
Lumnitzera littorea	quite rare (confined to 1 location)
Merrilliodendron megacarpum	quite rare (confined to 2 locations
Pisonia umbellifera	endangered
Planchonella obovata	rare
Serianthes nelsonii	endangered
Tabernaemontana rotensis	endangered (not found)
Tarenna sambucina	rare
Tephrosia mariana (legume)	not found
Terminalia littoralis	rare
Tristiropsis acutangula	rare
Xylocarpus moluccensis	rare
Xylosma nelsonii	rare (not found)

APPENDIX D

United States Department of the Interior

FISH AND WILDLIFE SERVICE
300 ALA MOANA BOULEVARD
P.O. BOX 50167
HONOLULU, HAWAII 96850

IN REPLY REFER TO:

OCT 2 1 1986

James E. Maragos, Chief
Environmental Resources Section
Planning Branch
U.S. Army Engineer District, Honolulu
Bldg. T-1
Ft. Shafter, Hawaii 96858

Dear Dr. Maragos:

This is the report of the U.S. Fish and Wildlife Service (Service) concerning the fish and wildlife resources of the Uruno Point area, Guam, and the environmental consequences of proposed waste material removal activities at Uruno Point. At the request of Ms. Helene Takemoto of your staff, the Service conducted biological surveys of the project site incidental to other Service activities on Guam between July 14 - 17, 1986.

This report was written by Service biologists John Ford and Derral Herbst. The scope of this report addresses only terrestrial vegetation and marine resources at the project area. A separate survey and evaluation of avifauna, mammals, and reptiles was conducted for the Army by Robert C. Fleischer of the University of Hawaii. We acknowledge the assistance of Mr. Harry Kami, Bob Anderson and Gary Wiles of the Guam Aquatic and Wildlife Resources office; and Vern Tobey of Anderson Air Force Base. We thank Andrew Hutchko of Santa Rita, Guam, for the use of his boat and his nautical expertise. Frank Dayton of the Army's Guam Operations Office assisted with field surveys of the marine habitats.

SITE DESCRIPTION

The project area encompasses approximately 430 acres of steep limestone forest lands and coastal coconut forest between Achae Point and the northern boundary of the Haputo Ecological Reserve Area at Finegayan, Guam (fig. 1). This area encompasses Uruno Point and Falcona Beach. A detailed description of site physiography, geology, soils, and hydrology is provided in Randall and Holloman (1974).

The entire project area lies within private property owned by the Artero family of Guam. During and after World War II (WWII), scrap material and ordnance items were pushed by American military personnel over the steep limestone cliffs into Artero property. A recent survey of the property by an Air Force explosive ordnance disposal squadron revealed the presence of

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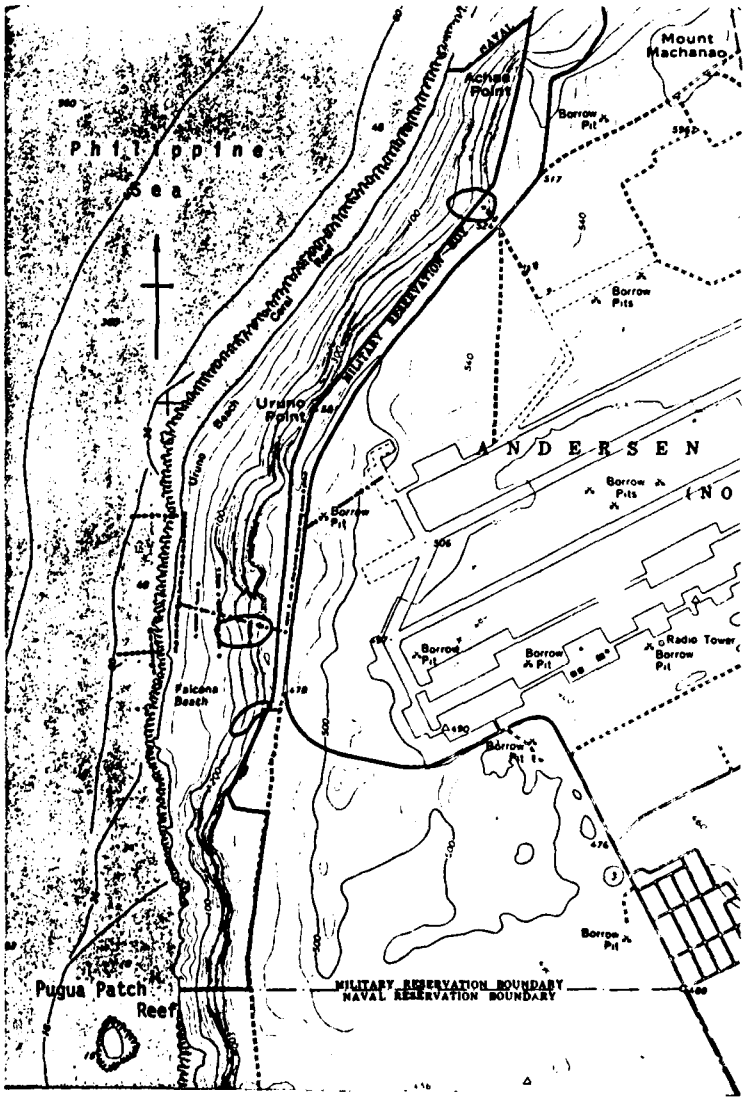

Figure 1. The Artero Property and Uruno Point Study Area. Dotted lines indicate marine transect locations; dashed lines represent botanical surveys; open circles indicate three main areas of contamination.

aircraft tires and parts, vehicle parts, incendiary bomblets and 100 lb incendiary bombs, target identification bombs, live fragmentation grenades, and small arms ammunition dating back to WWII. After this material was dumped, it was apparently covered with Napalm (jellied gasoline), and burned. The residue and unburned ordnance items have accumulated on the property at various depths, up to at least five feet. Service biologists found WWII aircraft tires, empty 55 gallon drums and smaller containers, and pressurized gas containers during their survey, but saw no ordnance items. The explosive ordnance team estimated that roughly 13 acres of land within the project area were heavily contaminated with dangerous materials.

PROJECT DESCRIPTION

The U.S. Army Engineer District, Honolulu has been tasked by the Air Force to prepare environmental documentation and planning assistance for the removal of these materials from the Artero property. The precipitous, densely vegetated terrain makes removal of the debris particularly difficult. Several alternative means of waste material removal are under consideration by the Army, including:

a) removal of debris up the cliff face via conveyor belt, dragline, and/or oversized crane;

b) removal of debris by helicopter, necessitating the construction of helipads adjacent to and within the property;

c) removal of debris by truck over new roads;

d) removal of debris by sea via barge.

Various levels of debris removal (partial, complete) are also being considered. Virtually all alternatives will involve the construction of new roads within or adjacent to the property. Removal of debris by barge would necessitate construction of a small barge harbor near Falcona Beach, and associated dockside facilities. Alternatives under consideration which involve little or no land clearing include fencing the contaminated areas, purchase of the property, property exchange or condemnation, and no action.

FISH AND WILDLIFE RESOURCES

I. TERRESTRIAL VEGETATION

A. Methods

On July 15-18, 1986, a walk-through reconnaissance survey was made of the proposed Uruno Point project site. The project

proposes to remove debris dumped by the military on Artero property adjacent to Andersen Air Force Base. The purpose of the survey was to assess the vegetation of the area and the impact of the proposed project on it, and to determine if plants proposed or listed as endangered or threatened by the Federal or Territorial governments are present on the project site.

B. Description of the Vegetation

The project site was divided into three geographical units. The first unit consisted of the area between the cliff edge to the vegetation line, back of the beach. It is comprised of three vegetation types: limestone forest, cocohut forest, and coastal or strand vegetation. The dumpsites are mainly in the limestone forest and the edges of the coconut forest. The second geographical unit consisted of the flat area or plateau from the edge of the cliff inland to the boundaries of the project site. The vegetation of this area consisted chiefly of a mixed native and exotic forest with some areas as roads and roadsides, highly disturbed and vegetated mostly with non-native plants. The third unit consisted of the sides and floor of an old borrow pit remaining from the construction of the air base runways. Its vegetation consisted of a mixture of native and exotic herbs and shrubs with a few small trees present, these mostly along its boundaries.

At least 138 species of higher plants were found in these geographical units. Table 1 lists the status of vascular plants within each unit.

Table 1. Status of the vascular plants in the proposed Uruno project site.

	Status			
	Native		Exotic	
Area	Species present	(%)	Species present	(%)
Cliff edge to beach	70	(74)	25	(26)
Plateau	46	(50)	46	(50)
Borrow pit	22	(56)	17	(44)
All habitats	85	(62)	53	(38)

1. Coastal or Strand Vegetation. The coastal or strand vegetation of Guam comprised of three subtypes, emerged coral limestone, sandy beach, and low swampy coast (Fosberg 1960). The low swampy coast is uncommon on Guam and is not present on the northern part of the island. Most of the coastal vegetation at the project site is of the sandy beach subtype. The principal tree species noted in this zone are Tournefortia argentea, Cordia subcordata, Guettarda speciosa, Thespesia populnea, and Cocos nucifera. The grass, Lepturus repens, and the vines, Ipomoea pes-caprae and Canavalia cathartica are the dominant herbaceous species, and along with Triumfetta procumbens and other, less common species, forms a low, sparse ground cover. The vegetation quickly intergrades into the coconut forest on the sandy flats behind the beach.

Epiphytic species are common on the trees of this vegetation zone. The most common vascular epiphytes are Teeniophyllum marianense, an orchid consisting mostly of photosynthesizing roots, and the ferns Pyrrosia lanceolata, Phymatodes scolopendria, and Polypodium punctatum.

2. Limestone Forest. The limestone forest is one of the most important and extensive vegetation types in the Mariana Islands. The vegetation along the cliffs at the Uruno project site is of this type. It is extremely mixed in character and, although certain species may be dominant in small, localized areas, it is difficult to characterize the vegetation by reference to dominant species. The Uruno limestone forest is in a relatively natural state with few exotic species other than Triphasia trifolia, which is common and widespread throughout the area, and the dump sites whose vegetation cover consists almost entirely of exotic species.

Three herbs in the composite family Bidens alba, Mikania scandens, and Chromolaena odorata; the grass, Saccharum spontaneum; and the shrub, Leucaena leucocephala are the dominant species of the dump sites. The dominance of these plants over the dump sites makes the sites easily recognizable when viewed from offshore.

The most common trees of the limestone forest are Pandanus dubius, P. fragrans, Artocarpus altilus, Ficus spp., Aglaia marianensis, Guamia mariannae, Eugenia reinwardtiana, Premna obtusifolia, Melanolepis multiglandulosa, Macaranga thompsonii, Neisosperma oppositifolia, Morinda citrifolia, Dendrocnide latifolia, and Cycas circinalis.

Occasionally, small areas dominated by a single species, Pandanus dubius and Barringtonia asiatica, for example, can be found in the forest, but most are too small to map. The

vegetation of the steep cliffs consists of dwarfed forms of the limestone forest elements, but favor certain species such as Mammea odorata and Ficus tinctoria along with emerged limestone coastal vegetation species such as Hibiscus tetrandra and Hedyotis spp.. At the interface between the limestone forest and disturbed vegetation types such as the plateau area, certain species such as Annona reticulata and Leucaena leucocephala tend to be more common.

Several large Ficus spp. were defoliated by the larvae of the butterfly Euploea leucostictus and Leucaena leucocephala stands were defoliated by the recently introduced jumping plant lice.

3. Coconut Forest. The coconut forest vegetation type at the Uruno project site is restricted to the sand flats behind the beach. Bamboo and Alocasia macrorrhiza along with latte stones, grinding stones, and the dense stand of coconut trees attest to the long history of use of the area by man. The ground was covered with litter, principally fronds and rotting coconuts, and some species from the surrounding limestone forest had invaded. Piper guahamense was a common large herb and saplings of Aglaia mariannensis, Neisosperma oppositifolia, Morinda citrifolia, and Cycas circinalis were observed. The trunks of the coconut trees were rich with epibytes, bryophytes, orchids, and ferns.

4. Disturbed Areas. In addition to the dump sites mentioned above, two other areas may be impacted by the proposed project, the plateau area and the borrow pit area. The plateau area vegetation consists chiefly of a degraded forest of native and exotic trees; the ground cover is now comprised mostly of exotic forbes, grasses, and shrubs. A few small pockets of native limestone forest are found in the plateau area, but they are not common. The borrow pit floor and sides are of limestone with large, open, bare areas. The vegetation consists mostly of common exotic herbs such as Stachytarpheta jamaicensis, Bidens alba, and Euphorbia spp.. A few natives such as Ophioglossum nudicaule, Scaevola taccada, and Phyllanthus marianus grow intermixed with the more common exotics.

The plants of the three areas are enumerated in Table 2, a checklist of the vascular plants of the proposed project site.

5. Endangered Plants. Three species of plants are officially recognized by the Territory of Guam as endangered species. These are Cyathea lunulata, Serianthes nelsonii, and Heritiera longipetiolata. In 1981, the Governor of Guam petitioned the U.S. Fish and Wildlife Service to list these three species as endangered. The Service declined to list Cyathea lunulata as it is common on many Pacific Islands. The Service

Table 2. Checklist and relative abundance of the vascular plants of the Urunao Beach Project Site.Key to status column: N=native; X=exotic. Key to abundance codes: A=abundant; C=common; O=occasional; R=rare; U=uncommon; - = not present. *Strand, Cliff, Coconut, and Limestone Forest vegetation zones.

	Status	Cliff to Beach*	Plateau	Borrow Pit
PTERIDOPHYTA				
OPHIOGLOSSACEAE				
Ophioglossum nudicaule L.f.	N	-	-	O
PSILOTACEAE				
Psilotum nudum (L.) Beauv.	N	-	-	R
POLYPODIACEAE				
Asplenium nidus L. (galak fedda', galak)	N	A	O	-
Davallia solida (Forst. f.) Sw. (pugua' machena)	N	C	U	-
Nephrolepis acutifolia (Desv.) Christ (amaru)	N	O	-	-
Nephrolepis hirsutula (Forst. f.) Pres.	N	C	C	C
Phymatodes scolopendria (Burm. f.) Ching (Kahlaonese)	N	C	U	C
Polypodium punctatum (L.) Sw. (galak dalalai)	N	A	-	-
Pteris tripartita Sw.	N	C	O	O
Pyrrosia lanceolata (L.) Farw.	N	C	-	O
Tectaria crenata Cav.	N	O	-	-
Vittaria incurrata Cav.	N	O	-	-
GYMNOSPERMAE				
CYCADACEAE				
Cycas circinalis L. (fadang, federiku)	N	C	O	-

Table 2 - continued

	Status	Cliff to Beach	Plateau	Borrow Pit
MONOCOTYLEDONAE				
ARACEAE				
Alocasia macrorrhiza (L.) G. Don (piga')	X	O	-	-
CYPERACEAE				
Cyperus ligularis L. (rocket-sedge)	X	-	-	R
Fimbristylis sp.	N	-	O	O
DIOSCOREACEAE				
Dioscorea bulbifera L. (makna huegu)	N	U	-	-
FLAGELLARIACEAE				
Flagellaria indica L. (bayogon halom tano')	N	C	O	-
GRAMINEAE				
Bambusa vulgaris Wendl. (piao palaoan)	X	O	-	-
Cenchrus echinatus L. (lamo' katu)	X	O	O	-
Centotheca lappacea (l.) Desv.	N	O	-	-
Chloris inflata Link (fingergrass)	X	-	O	-
Chrysopogon aciculatus (Retz.) Trin. (inifuk)	N	-	O	-
Cynodon dactylon (L.) Pers. (Bermuda-grass)	X	O	O	-
Dichanthium bladhii (Retz,) Clayton	X	-	C	U
Eleusine indica (L.) Gaertn. (umok)	X	U	O	-
Eustachys petraea (Sw.) Desv.	X	-	O	O
Lepturus repens (Forst.) R. Br. (lasaga)	N	C	-	-
Paspalum conjugatum Berg.	X	O	-	-
Paspalum fimbriatum HBK.	X	-	U	-

Table 2 - continued

	Status	Cliff to Beach	Plateau	Borrow Pit
BIGNONIACEAE				
Spathodea campanulata Beauv. (African tulip tree)	X	-	U	-
BORAGINACEAE				
Cordia subcordata Lam. (niyoron)	N	U	-	-
Heliotropium procumbens var. *depressum* (Cham.) Fosb. & Sachet (hunek tasi)	N	-	O	-
Tournefortia argentea L. f. (hunek)	N	O	-	-
CAMPANULACEAE				
Hippobroma longiflora (L.) G. Don (star of Bethlehem)	X	-	U	-
CARICACEAE				
Carica papaya L. (papaya)	X	O	C	-
CASUARINACEAE				
Casuarina equisetifolia L. (gagu)	N	O	C	O
CELASTRACEAE				
Maytenus thompsonii (Merr.) Fosb. (luluhot)	N	O	O	U
COMBRETACEAE				
Terminalia catappa L. (talisai)	N	O	-	-
COMPOSITAE				
Bidens alba (L.) DC. (begger's tick)	X	C	A	C
Chromolaena odorata (L.) King & Rob.	X	C	A	A
Conyza canadensis var. *pusilla* (Nutt.) Cronq.	X	-	U	O
Mikania scandens (L.) Willd.	X	C	C	A
Tridax procumbens L. (coat buttons)	X	-	O	-
Wedelia biflora var. *capescens* (Gaud.) Fosb. (masiksik)	N	O	-	-

Table 2 - continued

	Status	Cliff to Beach	Plateau	Borrow Pit
CONVOLVULACEAE				
Ipomoea indica (Burm.) Merr.	N	O	O	-
Ipomoea pes-caprae ssp. *brasiliensis* (L.) v. Ooststr. (alalak tasi)	N	O	-	-
CUCURBITACEAE				
Momordica charantia L. (atmagosu)	X	U	C	-
EUPHORBIACEAE				
Euphorbia chamissonis (Kl. & Gke.) Boiss. (beach spurge)	N	O	-	-
Euphorbia cyathophora Murr. (dwarf poinsettia)	X	-	-	O
Euphorbia hirta L. (golondrina)	X	O	C	O
Glochidion marianum Muell.-Arg. (chosgo)	N	C	U	-
Macaranga thompsonii Merr. (pengua)	N	C	C	O
Melanolepis multiglandulosa var. *glabrata* (Muell.-Arg.) Fosb. (alom)	N	O	U	U
Phyllanthus marianus Muell.-Arg. (gaogao uchan)	N	C	C	C
GOODENIACEAE				
Scaevola taccada (Gaertn.) Roxb. (nanasu)	N	O	-	U
GUTTIFERAE				
Mammea odorata (Raf.) Kosterm. (chopak)	N	C	-	-
HERNANDIACEAE				
Hernandia sonora L. (nonnak)	N	O	-	-
LAURACEAE				
Cassytha filiformis L. (mayagas)	N	-	O	O
LECYTHIDACEAE				
Barringtonia asiatica (L.) Kurz (puteng)	N	O	-	-

Table 2 - continued

	Status	Cliff to Beach	Plateau	Borrow Pit
Pennisetum purpureum Schum. (napier grass)	X	U	C	-
Saccharum spontaneum L. (wildcane)	X	O	C	-
Sporobolus fertilis (Steud.) Clayton	X	O	C	-
Stenotaphrum micranthum (Desv.) Hubb.	N	O	-	-
Thuarea involuta (Forst.) R. & S. (lasaga)	N	U	-	-
ORCHIDACEAE				
Nervilia aragoana Gaud. (sayaihagon)	N	-	R	-
Spathoglottis plicata Bl.	N	-	O	O
Taeniophyllum marianense Schltr. (Kamuten nanoffe, amot otdon)	N	O	O	-
PALMAE				
Cocos nucifera L. (niyok)	X	C	O	-
PANDANACEAE				
Pandanus dubius Spreng. (pahong)	N	C	O	-
Pandanus fragrans Gaud. (kafo')	N	C	C	-
DICOTYLEDONAE				
ACANTHACEAE				
Blechum brownei Juss. (yatbas babui)	X	O	O	-
ANNONACEAE				
Annona reticulata L. (anonas)	X	-	O	-
Guamia marianae (Safford) Merr. (paipai)	N	C	U	R
APOCYNACEAE				
Neisosperma oppositifolia (Lam.) Fosb. & Sachet (fago')	N	C	C	-

Table 2 - continued

	Status	Cliff to Beach	Plateau	Borrow Pit
LEGUMINOSAE				
Abrus precatorius L. (kulales)	X	-	R	-
Alysicarpus vaginalis (L.) DC.	X	-	O	-
Canavalia cathartica Thou. (lodosong tasi)	N	O	O	-
Cassia sp.	X	U	-	-
Cynometra ramiflora L. (gulos)	N	C	-	-
Delonix regia (Boj.) Raf. (atbot)	X	-	R	-
Intsia bijuga (Colebr.) O. Ktze. (ifet)	N	C	-	-
Leucaena leucocephala (Lam.) de Wit (tangantangan)	X	O	A	O
Sophora tomentosa L.	N	U	-	-
LOGANIACEAE				
Buddleja asiatica Lour.	X	-	U	-
Polypremum procumbens L.	X	-	R	-
LYTHRACEAE				
Pemphis acidula Forst. (nigas)	N	O	-	-
MALVACEAE				
Hibiscus rosa-sinensis L. (flores rosa)	X	-	R	-
Hibiscus tiliaceus L. (pagu)	N	O	O	U
Malvastrum coromandelianum (L.) Garcke	X	-	O	O
Sida rhombifolia L. (escobilla dalili)	X	-	O	-
Thespesia populnea (L.) Correa (banalu, kilu)	N	O	-	-
MELIACEAE				
Aglaia mariannensis Merr. (mapunao)	N	C	O	U

Table 2 - continued

	Status	Cliff to Beach	Plateau	Borrow Pit
MORACEAE				
Artocarpus altilis (Park.) Fosb. (lemmai)	X	O	O	-
Artocarpus altilis (Park.) Fosb. x *mariannensis* Trec.	N	O	O	-
Ficus prolixa Forst. f. (nunu)	N	O	O	-
Ficus tinctoria Forst. f. (hoda, tage'te')	N	O	O	-
MYRSINACEAE				
Discocalyx megacarpa Merr. (ottot)	N	O	-	-
MYRTACEAE				
Eugenia bryanii Kaneh.	N	U	-	-
Eugenia reinwardtiana (Bl.) DC. (a'abang)	N	C	O	U
Psidium guajava L. (abas)	X	-	O	-
NYCTAGINACEAE				
Pisonia grandis R. Br. (omumu)	N	O	-	-
OLEACEAE				
Jasminum mariannum DC. (banago)	N	O	U	U
PASSIFLORACEAE				
Passiflora suberosa L. (wild passion flower)	X	O	O	O
PIPERACEAE				
Peperomia mariannensis C. DC. (potpot palao'an)	N	O	-	-
Piper guahamense C. DC. (pupulon aniti)	N	C	O	-
POLYGALACEAE				
Polygala paniculata L.	N	-	O	-

Table 2 - continued

	Status	Cliff to Beach	Plateau	Borrow Pit
RHAMNACEAE				
Colubrina asiatica (L.) Brongn. (gaso'so')	N	C	C	-
RUBIACEAE				
Aidia cochinchinensis Lour. (sumak)	N	O	-	-
Bikkia tetrandra (L. f.) A. Rich. (gaosali)	N	C	R	-
Guettarda speciosa L. (panao)	N	C	U	-
Hedyotis corymbosa (L.) Lam.	X	-	O	-
Morinda citrifolia L. (ladda)	N	C	C	-
Morinda umbellata var. *glandulosa* (Merr.) Fosb.	N	-	R	-
Psychotria mariana DC. (aplohkateng)	N	O	-	-
Spermacoce assurgens R. & P.	X	-	O	O
Spermacoce ernstii Fosb. & Powell	X	U	U	-
Timonius nitidus (Bartl.) Villar (sumak lada)	N	-	-	R
RUTACEAE				
Citrus sp.	X	-	R	-
Triphasia trifolia (Burm. f.) P. Wils. (lemon China)	X	C	C	O
SCROPHULARIACEAE				
Buchnera floridana Sm.	X	-	O	-
SOLANACEAE				
Capsicum frutescens L. (donne' sali)	X	U	U	U
STERCULIACEAE				
Melochia compacta Hochr. (sayafi)	N	-	O	-
Waltheria indica L. (escobilla sabana)	N	-	O	-

Table 2 - continued

	Status	Cliff to Beach	Plateau	Borrow Pit
THYMELAEACEAE				
Wikstroemia elliptica Merr. (gapit atagaki)	N	-	-	U
TILIACEAE				
Elaeocarpus joga Merr. (yoga)	N	-	U	-
Triumfetta procumbens Forst. f. (masigsig hembra)	N	O	-	-
URTICACEAE				
Dendrocnide latifolia (Gaud.) Chew	N	C	U	-
Elatostema calcareum Merr. (tupon ayuyu)	N	C	-	-
Laportea ruderalis (Forst. f.) Chew	N	O	-	-
Pilea microphylla (L.) Liebm.	X	-	O	C
Pipturus argenteus (Forst. f.) Wedd. (amahatyan)	N	O	O	-
Procris pedunculata (Forst.) Wedd.	N	C	-	-
VERBENACEAE				
Clerodendrum buchananii var. *fallax* (Lindl.) Bakh.	X	O	-	-
Lippia nodiflora (L.) Rich.	X	-	R	-
Premna obtusifolia R. Br. (ahgao)	N	C	C	-
Stachytarpheta jamaicensis (L.) Vahl (false verbena)	X	-	C	C
Vitex parviflora Juss. (lagunde)	X	-	O	-

also declined to list Heritiera longipetiolata as it is known from several islands (Saipan, Tinian, Guam, and perhaps Rota), where it is not a particularly rare species. The U.S. Fish and Wildlife Service has proposed that S. nelsonii be placed on the Federal endangered species list (Federal Register 50(207):43423-43426, 25 October 1985).

Cyathea lunulata, although rare on Guam, is fairly common and widespread in Micronesia and Polynesia. It is a tree fern known on Guam only from the ravine forests in the southern half of the island, and would not be expected to be found in the Uruno area.

Serianthes nelsonii, a large tree in the bean family, is endemic to the islands of Guam and Rota. On Guam it presently is known from a single individual at Ritidian Point. The tree, with its rust-brown foliage, is easily distinguished from other forest vegetation. None were seen at the Uruno project site.

Heritiera longipetiolata is a short, stout tree presently considered endemic to the Mariana Islands. Limestone cliffs and plateaus are its normal habitat and it is a component of the remnant limestone forests of these areas. The tree's large leaves with their dark green upper surface and tawny-silvery lower surface make it a somewhat conspicuous element of the vegetation. None were seen at the Uruno site, although they are known to be a component of the limestone forests of northern Guam.

II. MARINE RESOURCES

A survey of nearshore marine resources was conducted in the event that a waste removal alternative involving harbor construcion was selected as the preferred plan.

A. Methods

The location of the different marine habitat types offshore of the study area was determined by published literature, and surveys with mask and snorkel. Three transects were arbitrarily selected to be representative of the particular habitat type. The transects generally followed a depth gradient or were perpendicular to shore (fig. 1). All corals lying across each transect line were recorded; however, no quantitative measurements of coral size or abundance were made.

Fishes were recorded by means of a visual census technique (Brock 1954). The direct visual census provides a quick, non-destructive method where successive samples may be conducted in the same place. A SCUBA diver swam the length of the transects

placed for coral studies and recorded on an underwater slate all fishes within 1 m on either side of the transect, and within 2 m above the transect. Each transect was surveyed twice, once in each direction. It took approximately 20 minutes to complete one transect count. Following this, an incidental count of fishes was made for an equivalent amount of time in the vicinity of, but not restricted to, the transect.

Incidental fish observations and transect counts within each habitat type were consolidated (along with records from the published literature). Hence, these data could not be used in the calculation of density. Estimates of biomass, dominance, importance value, and diversity (Jones and Chase 1975) were not attempted in this survey. Calculation of these indicies would have required the estimation of the lengths of each fish observed. Length estimates generally require a substantial amount of diver training and practice before accurate and meaningful estimates can be made (Bell et al. 1985).

B. Description of Marine Habitats

1. Shoreline. The shoreline south of Falcona Beach is dominated by steep rocky slopes and cliffs fronted by a narrow sea level bench. The rocky slopes and benches are comprised of reef (QTmr) and detrital (QTmd) facies of the Mariana limestone formation and are extensions of the limestone cliffs (Tracey et al. 1964, Randall and Holloman 1974). The sea level benches are narrow, less than 3 m wide, and are nearly continuous throughout the Haputo RRA to the south. The rocky slopes and benches are cut by vertical fractures, joints, fissures, and erosional nips. Large blocks of limestone broken from the adjacent cliff faces are scattered along the shoreline.

A 30 - 60 foot wide beach extends from Achae Point to the southern end of Falcona Beach. Randall and Holloman (1974) report that the beach is composed entirely of bioclastic materials (shell fragments, foraminifera, coral rubble). The beach is interrupted by two small, rocky headlands between Uruno Point and Falcona Beach. Freshwater rivulets are present within the intertidal zone at several locations along the beach.

2. Fringing Reef. The inner reef flat is roughly the same width as the beach, and also consists of bioclastic materials which have been cemented to form a gently sloping platform. There is a poorly developed, shallow moat system present in several places along the inner reef flat. The outer fringing reef flat varies from 165 ft to 525 ft wide, and has scattered patches of exposed limestone interspersed with sand patches and Acropora thickets. The reef front, or crest, is cut by a groove-and-spur system, which in many places, is covered with massive coral growth. Off Falcona Beach, the reef crest is approximately 15 ft deep, and is laced with interconnecting caverns and deeply incised surge channels.

3. Reef Slope and Terrace. The substratum seaward of the reef crest consists of exposed limestone substratum which is scored with surge channels and sand patches. The bottom decends gradually over this shallow terrace from 15 ft at the reef crest to approximately 55 ft, some 200 yards offshore. There is little coral growth in this habitat. Both Randall and Holloman (1974) and Dickinson and Tsuda (1975) suggested that the lack of corals here was due to a heavy infestation of the Crown-of-Thorns starfish (Acanthaster planci) in 1969. At that time, the starfish apparently killed most of the reef building corals in this habitat.

C. Corals

At least 11 families of reef-building corals representing 23 genera and 43 species have been reported from the nearshore marine habitats at Uruno Point. Table 3 presents a checklist of corals found within this area by Dickinson and Tsuda (1975). Other corals found during this survey include Leptastrea transversa Kuntzinger, Porites (P.) australiensis Vaughan, Scapophyllia cylindrica (Milne Edwards and Haime), and Stylocoeniella armata (Ehrenberg).

The fringing reef crest clearly has the greatest diversity and cover of stoney corals of the two marine habitat types within the project area.

It is anticipated that additional corals exist within the project area. Service biologists recorded 59 species of corals from 11 families within the nearby Haputo Ecological Reserve Area (ERA). However, the ERA encompasses a greater variety of habitat types than the area offshore of Uruno Point.

Table 4 is a list from Dickinson and Tsuda (1975) of other marine invertebrates observed in the vicinity of Uruno Point.

D. Fishes

A total of 92 species of reef fishes representing 59 genera and 26 families have been recorded within the marine habitats at Uruno Point. Table 5 presents a list of fishes observed at Uruno Point by Dickinson and Tsuda (1975) and by Service biologists in July, 1986.

The most common families of fishes within project area are the wrasses (Labridae) (15 species), damselfishes (Pomacentridae) (15 species), butterflyfishes (Chaetodontidae) (11 species), and surgeonfishes (Acanthuridae)(8 species).

Table 3. Checklist of corals recorded from the Uruno Point study area. Source: Dickinson and Tsuda (1975).

Species	Inner Reef Flat	Outer Reef Flat	Reef Terrace
Acanthastrea echinata (Dana)			X
Acropora abrotenoides (Lamarck)			X
A. aspera (Dana)		X	
A. hebes (Dana)	X	X	
A. humilus (Dana)			X
A. tubicinaria (Dana)		X	
Astreopora listeri (Bernard)			X
A. myriopthalma (Lamarck)			X
Coscinarea columna (Dana)			X
Cyphastrea chalcidicum (Forskaal)			X
C. serailia (Forskaal)			X
Favia pallida (Dana)			X
F. stelligera (Dana)			X
Favites virens (Dana)		X	
Fungia fungites var. incisa Doederlein			X
Goniastrea pectinata (Lamarck)			X
G. retiformis (Lamarck)	X	X	X
Heliopora coerulea (Pallas)			X
Leptastrea purpurea (Dana)			X
Leptoria phrygea Ellis & Solander			X
L. sp.		X	
Millepora dichotoma Forskaal		X	
M. exaesa Forskaal			X
M. platyphylla Hemprich & Ehrenberg			X
Montipora conicula Wells			X
M. floweri Wells			X
M. tuberculosa (Lamarck)			X
M. verrucosa (Lamarck)			X
Oulophyllia crispa (Lamarck)			X
Pavona clavus (Dana)			X
P. varians (Verril)		X	
Platygyra rustica (Dana)			X
Pocillopora damicornis (Linnaeus)	X	X	
P. verrucosa (Ellis & Solander)			X
P. sp.			X
Porites lichen (Dana)			X
P. lutea Milne Edwards & Haime	X	X	X
Psammocora contigua (Esper)	X	X	
Stylophora mordax (Dana)			X

Table 4. Checklist of the conspicuous macroinvertebrates in the Uruno Point study area. Source: Dickinson and Tsuda (1975)

PORIFERA
- Cinachyra australiensis (Carter)

MOLLUSCA
- Bivalvia
  - Tridacna maxima (Roding)
- Gastropoda
  - Conus chaldaeus Roding
  - C. ebraeus Linnaeus
  - C. miles Linnaeus
  - C. milliaris Hwass
  - C. sponsalis Hwass
  - Cymatium pileare Linnaeus
  - Cypraea moneta Linnaeus
  - C. tigris Linnaeus
  - Drupa ricinus (Linnaeus)
  - Lambis sp.
  - Latirus sp.
  - Thais tuberosa Roding
  - Nerita plicata Linnaeus
  - Trochus niloticus Linnaeus
  - Turbo argyrostoma Linnaeus
  - Vasum ceramicum (Linnaeus)
  - V. turbinellus (Linnaeus)

ECHINODERMATA
- Asteroidea
  - Choriaster granulatus Lutken
  - Culcita novaeguineae Muller & Troschel
  - Linckia laevigata (Linnaeus)
  - Linckia pacifica Gray
- Echinoidea
  - Echinometra mathaei (de Blainville)
  - Echinostrephus sp.
  - Echinothrix diadema (Linnaeus)
- Holothuroidea
  - Actinopyga echinites (Jaeger)
  - Bohadschia argus (Jaeger)
  - B. bivittata (Mitsukuri)
  - Holothuria (Halodeima) atra Jaeger
  - H. (Semperothuria) cinerascens (Brandt)
  - H. (Platyperona) difficilis Semper
  - H. (Thymiosycia) hilla Lesson
  - H. (Microthele) nobilis (Selenka)
  - Stichopus chloronotus Brandt

CRUSTACEA
- Diogenidae (hermit crabs)
  - Calcinus gaimardi (H. Milne Edwards)
  - Dardanus guttatus (Olivier)

Table 5. Fishes recorded at Uruno Point, Guam by FWS biologists July 16, 1986, and as previously recorded by Dickinson and Tsuda (1975). Fishes are listed in phylogenetic order.

Scientific name	Chamorro name	Habitat area: Fringing reef crest	Habitat area: Nearshore reef terrace
Holocentridae (Squirrelfishes)			
Sargocentron spinifer	Seniok	X	X
Myripristis berndti	Mespachi	X	X
M. kuntee	Mespachi	X	X
Engraulidae (Anchovies)			
Stolephorus sp.	Paya	X	
Serranidae (Groupers)			
Cephalopholis urodelus	Gadao	X	X
Priacanthidae (Bigeyes)			
Priacanthus cruentatus	Managas	X	X
Apogonidae (Cardinalfishes)			
Cheilodipterus quinquelineatus	Lansi	X	
Carangidae (Jacks)			
Caranx melampygus	Ro/Torakito	X	
Lutjanidae (Snappers)			
Aphareus furcatus	Guratan	X	X
Aprion virescens	Uku		X
L. fulvus	Kakaka		X
Caesionidae (Fusiliers)			
Pterocaesio tile	Bonita		X
Nemipteridae (Monocle Breams)			
Scolopsis cancellatus	Sihig		X
Lethrinidae (Emperors)			
Monotaxis grandoculus	Matanhagan		X
Mullidae (Goatfishes)			
Mulloidichthys flavolineatus	Salmonete		X
M. vanicolensis	Salmonete		X
Parupeneus bifasciatus	Salmonete		X
P. pleurostigma	Salmonete		X
P. porphyreus	Salmonete		X

Table 5. continued

Scientific name	Chamorro name	Habitat area: Fringing reef crest	Habitat area: Nearshore reef terrace
Kyphosidae (Rudderfishes)			
Kyphosus cinerascens	Guili	X	
Chaetodontidae (Butterflyfishes)			
Chaetodon auriga	Ababang	X	X
C. citrinellus	Ababang	X	X
C. ephippium	Ababang	X	X
C. lunula	Ababang		X
C. ornatissimus	Ababang	X	X
C. quadrimaculatus	Ababang	X	X
C. reticulatus	Ababang	X	
C. trifasciatus	Ababang	X	
C. unimaculatus	Ababang	X	
Megaprotodon trifascialis	Ababang	X	
Forcipiger flavissimus	Ababang		X
Pomacentridae (Damselfishes)			
Abudefduf sexfasciatus	Fomho	X	X
Amphiprion melanopus	Fomho	X	
Chromis caerulia	Fomho	X	X
Chrysiptera leucopomus	Fomho	X	X
C. glaucus	Fomho	X	X
C. traceyi	Fomho		X
Dascyllus aruanus	Fomho	X	X
D. reticulatus	Fomho	X	
Plectroglyphidodon dickii	Fomho	X	X
P. johnstonianus	Fomho	X	
P. leucozonus	Fomho		X
Pomacentrus vaiuli	Fomho	X	X
Pomachromis guamensis	Fomho	X	X
Stegastes fasciolatus	Fomho		X
S. nigricans	Fomho		X
Cirrhitidae (Hawkfishes)			
Cirrhitus pinnulatus		X	X
Paracirrhitus forsteri		X	

Table 5. continued

Scientific name	Chamorro name	Habitat area: Fringing reef crest	Habitat area: Nearshore reef terrace
Acanthuridae (Surgeonfishes)			
Acanthurus guttatus	Hugupau	X	X
A. lineatus	Hiyuk		X
A. mata	Hugupau		X
A. nigrofuscus	Hugupau	X	X
A. olivaceus	Hugupau		X
A. triostegus	Kichu	X	X
Ctenochaetus striatus	Hugupau	X	X
Naso lituratus	Hangun	X	X
Zanclidae (Morrish Idols)			
Zanclus cornutus	Ababang Gupalao	X	X
Bothidae (Lefteye Flounders)			
Bothus mancus	Tampat		X
Balistidae (Triggerfishes)			
Melichthys niger	Pulonon	X	
M. vidua	Pulonon	X	
Sufflamen bursa	Pulonon		X
S. chrysopterus	Pulonon	X	X
Rhinecanthus rectangulus	Humuhumu		X
Ostraciontidae (Boxfishes)			
Ostracion meleagris	Danglum	X	
Tetraodontidae (Smooth Puffers)			
Arothron nigropunctatus	Butete	X	
Canthigaster solandri	Butete		X
Total number of species per habitat area =		62	70

Table 5. continued

Scientific name	Chammoro name	Habitat area: Fringing reef crest	Habitat area: Nearshore reef terrace
Labridae (Wrasses)			
Cirrhilabrus sp.	Aaga	X	X
Coris aygula	Aaga	X	X
C. gaimardi	Aaga	X	X
Epibulus insidiator	Aaga	X	
Gomphosus varius	Corneta	X	X
Halichoeres hortulanus	Aaga	X	X
H. marginatus	Aaga	X	X
H. trimaculatus	Aaga	X	X
Hemigymnus fasciatus	Aaga		X
H. melapterus	Aaga		X
Labroides dimidiatus	Aaga	X	X
Stethojulis axillaris	Aaga	X	X
S. bandanensis	Aaga		X
Thalassoma hardwickei	Aaga	X	X
T. purpureum	Aaga	X	X
Scaridae (Parrotfishes)			
Bolbometapon muricatus	Palagsi/Lagua		X
Scarus frenatus	Palagsi/Lagua	X	
S. gibbus	Palagsi/Lagua	X	X
S. sordidus	Palagsi/Lagua	X	
Mugiloididae (Sand Perches)			
Parapercis clathrata	Machin	X	
Blenniidae (Blennies)			
Cirripectes polyzona	Machin	X	
Meiacanthus atrodorsalis	Machin		X
Gobiidae (Gobies)			
Eleotrides strigatus	Machin	X	
Nemateleotris magnificus	Machin		X
Pogonoculius zebra	Machin		X
Valenciennea strigatus	Machin	X	X

The most conspicuous fishes included the damselfishes Chromis caerulea, Chrysiptera leucopomus, Plectroglyphidodon dickii, P. leucozonus, and Pomachromis guamensis; the wrasse Thalassoma hardwickei; the parrotfishes Scarus gibbus and S. sordidus; and the surgeonfishes Acanthurus guttatus, Ctenochaetus striatus, and Naso lituratus. Forty of the 92 species of fishes listed from Uruno Point were observed in both habitat types.

It is anticipated that many more fishes than listed may inhabit the project area; however, many are cryptic and therefore difficult to enumerate. A total of 214 species of fishes was recently recorded by Service biologists from five distinct habitat types within the marine unit of the Haputo Ecological Reserve Area, located just south of the project area boundary. For example, fishes such as the anglerfishes (Antennariidae), and scorpionfishes (Scorpaenidae) may not have been recorded due to their deceptive coloration. Few large, predatory fishes, were observed. This may be due to a combination of factors including overfishing, lack of suitable shelter along shore and inadequate food supply. Sharks have been observed infrequently within the study area; however, they are generally seen seaward of the nearby Pugua Patch Reef. Small white tip reef sharks and black tip sharks occasionally pass through the moat and shallow reef areas.

ENVIRONMENTAL CONSEQUENCES OF PROJECT ALTERNATIVES

Specific estimates of habitat area and resource loss cannot be made at present since the Army has not developed a specific project plan. Therefore, the discussion of potential impacts must be general in its scope.

Although the dump sites are covered primarily with exotic vegetation, there will probably be minor damage to the surrounding limestone and coconut forests regardless of the method chosen for removing the debris.

If the debris is taken to the ocean to be barged out, then there will be greater impact on the coconut forest and the coastal or strand vegetation zones. This damage would be due to road building and the necessity to clear construction yards and stockpile areas. This alternative clearly has the greatest adverse environmental impacts.

The strand vegetation of the exposed ocean cliff faces should not be impacted regardless of disposal method chosen. The vegetation of the plateau will be impacted if the debris from the dump sites is removed from the top of the cliff and transported inland. The borrow pit vegetation will be completely destroyed if the pit is used to contain the debris from the dumpsites.

No endangered species of plants will be affected by the proposed project.

Breeding biology of the Mariana Crow (Corvus tropicus), a listed endangered species, may be adversely impacted if waste removal operations entail excessive noise and disturbance of the limestone forest.

Construction of a barge harbor and entrance channel for waste disposal transport would result in substantial damage to the diverse fringing reef and reef terrace habitat near Uruno Point. Construction may also damage the integrity of the nearby Haputo Ecological Reserve Area by suspended sediment drift. We strongly discourage the use of this alternative.

RECOMMENDED ALTERNATIVE

From a biological standpoint, the least environmentally damaging alternative for debris removal would be to remove the wastes from the top of the cliff and transport them over existing roads to a landfill. Whether this is accomplished by crane or conveyer belt is probably irrelevant; provided that disturbance to the limestone forest is minimized.

We discourage the use of helicopters and extensive road building because of disturbance to the limestone forest habitat and to the breeding biology of the endangered Mariana Crow.

RECOMMENDED MITIGATION

Any equipment used on the project should be cleaned and inspected for weed seeds before being brought into the project area.

Once the debris is removed, sterilized soil should be put in the dump sites and planted with native limestone forest species to prevent erosion and to attempt to prevent the establishment of exotic species in the area.

Explosives should not be used, and disturbance to the limestone forest should be minimized.

Should construction of a barge harbor be proposed, additional mitigation measures will need to be developed and applied.

The Service requests that detailed project proposals, once formulated, be forwarded for our review and comment.

Sincerely,

Ernest Kosaka
Project Leader
Office of Environmental Services

cc: RD, Portland, OR (AFWE)
EPA, San Francisco
GAWR
Vern Tobey, USAF, Andersen AFB

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APPENDIX E

Report of a Wildlife Survey Conducted on the Artero Property and Andersen Air Force Base, Guam, during 15-19 July 1986.

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Introduction

This report summarizes the results of a wildlife survey conducted on the Artero property adjacent to Andersen Air Force Base (AAFB) in northern Guam (Fig. 1) during 15 to 19 July 1986. The study area contained three sites into which refuse had been dumped from the cliff edge onto the slopes below (called "dump sites" from here on). The Air Force has been mandated to conduct a cleanup of the accumulated debris. The results of this wildlife survey will be used in the preparation of an environmental impact statement for the proposed cleanup.

The primary goal of the study was to document the presence and distribution of endangered native species in the area, in particular, representatives of Guam's vanishing avifauna (Jenkins 1983; Engbring and Ramsey 1984; Savidge 1984, in press). The second goal was to determine the presence of other native and non-native species, including those that might be damaging or disruptive to natural habitats (e.g. feral pigs [Sus scrofa], monitor lizards [Varanus indicus], etc.). In addition to surveys in situ, information from previous studies of Guam's wildlife (Baker 1951; Wheeler and Aguon 1978; Wheeler 1979; Jenkins 1983; Engbring and Ramsey 1984; Savidge 1984, in press; Wiles unpubl.) was incorporated into the study. Data concerning organisms previously found in the area may be particularly important if re-introductions from captive populations or translocations from extant wild populations are conducted in the future.

Study Site and Habitats

The study area occurred atop and along the bluffs between Achae Point and Falcona Beach adjacent to Northwest Field in AAFB (Ritidian Point Quadrangle, USGS; Fig. 1). It included three refuse dump sites varying in size and extent (Fig. 1). Two of the sites were located in the southern half of the study area, and were about 0.5 km apart. This southern section was surveyed with a single transect. The third dump site was located about 2.1 km north of the second. This dump site and its surroundings were surveyed by a separate transect.

The study area contains two major habitats: second growth (or scrub) and mature limestone forest. The former habitat predominates in the areas in which the debris was deposited, and along the edges of roads. It is a mix of grass and small to medium-sized shrubs (such as Casuarina, Pandanus, Hibiscus and Scaevola). Most of the habitat surrounding these dump sites was undisturbed and mature

limestone forest. This forest did not often exceed 15 m in height, especially along the cliff face, and was composed largely of Pisonia and Pandanus (Jenkins 1983). Because these two habitats correspond almost completely to the dump sites (second growth) and their surroundings (limestone forest), no separate habitat map is provided.

Methods

Wildlife were documented in the study area during four visits (15, 16, 17, and 19 July 1986). On 15 July, observations were made during an unsystematic walk along the cliff face between dump sites 1 and 2, and at site 3. This walk took place between about 09:30 and 15:00, and was conducted with other members of the survey team.

On 16 July, a systematic station census was conducted from just south of dump site 2 to about 500 m north of dump site 2 (stations 1-4, Fig. 1). A systematic count was also made at dump site 3 (station 5). The transect consisted of walking along the slope face (about 10-20 m below the top of the cliff) and stopping at the stations (spaced about 100-125 m apart) to count wildlife (Fig. 1). The transect line was in forest except when it actually crossed a dump site, where it went through low and grassy second growth. A two minute "settling down" period was conducted upon arrival at each station. All birds, mammals, reptiles and snails sighted or heard were then counted during an 8-minute observation period. The 16 July transect was completed between 06:00 and 11:00. A survey was also conducted by walking along the road (see Fig. 1 for exact transect location) and counting all birds, mammals and reptiles seen or heard. This survey was conducted between 09:00 and 10:00. A similar survey was repeated along the road on 19 July 1986 between 07:30 and 08:00.

On 17 July 1986 playbacks of taped vocalizations of four species of native Guamanian birds were conducted at seven stations at or near the three dump sites. The recordings were supplied by the Guam Aquatic and Wildlife Resources Division (GAWRD) from a tape made by H. D. Pratt, Jr. The tape was played back on a Sony TCM-5000EV cassette recorder at full volume. Vocalizations could be heard by my ear up to 40 m away from the speaker. The species played back were ones known to have occurred in or near the study area in recent years but which may be extirpated at the present time. These included the Micronesian Kingfisher (Halcyon cinnamomina), the Mariana Fruit Dove (Ptilinopus roseicapilla), the Micronesian Starling (Aplonis opaca), and the Cardinal Honeyeater (Myzomela cardinalis). On two occasions recordings of the Mariana crow and the Guam rail

were played. Vocalizations for each species were played for about 3-4 minutes, and the species were ordered unsystematically. Responses were listened for during the playback and for about 1 minute of silence following the playback. The playbacks were conducted between 06:00 and 10:00.

A final survey was conducted on 19 July in Northwest Field of AAFB at a borrow pit about 0.7 km northeast of dump site 2 (Fig. 1). This borrow pit had been designated as a possible site in which to place the debris from the Artero property. Micronesian kingfishers had been seen at this site as recently as June (GAWRD, unpubl.). The survey of this area was conducted between 06:30 and 07:30.

Literature and personal sources of information were also consulted for data. Literature sources were surveyed for references to the site. On 18 July 1986, several hours were spent at the GAWRD office on Guam. Publications of the GAWRD and its personnel were obtained and the distributions of and recent changes in Guam's wildlife populations were discussed with the GAWRD's biologists.

Results and Discussion

I first present the results of the station and road surveys and the playback experiments. This is followed by an annotated inventory of the observed fauna, which includes a summary of all observations in the study area and results from surveys of the literature. I conclude this section with an inventory of fauna not observed in the present study but which were known from historical records to have once occurred in the study area.

The station survey on 16 July 1986 included five stations (see Fig. 1, Table 1). No birds were seen or heard during the 40 minutes of station counts, but one Mariana crow (Corvus kubaryi; Fig. 5) was seen and heard just prior to the count at station 1. The vertebrates seen most during the counts were skinks (Table 1). Many spiders of the genus Argiope (Fig. 9) and African snail shells (Achatina) were also observed (Table 1). Because no species of note were observed during the station counts the data from them are summarized rather than presented station by station. The road surveys on 16 and 19 July 1986 involved much less time in comparison to the station counts, but provided the greatest numbers of sightings of birds (3 species; Table 1), including the endangered Mariana crow.

The seven playback experiments conducted on 17 July 1986 elicited no responses from birds, although two black

drongos (Dicrurus macrocercus), 2-5 Mariana crows and a Philippine turtle dove (Streptopelia bitorquata) were documented between the playbacks. The survey of the borrow pit on 19 July 1986 revealed no Mariana kingfishers, however drongos were heard giving a rattle similar to (and perhaps mimetic of) that of the kingfisher. In addition, four Philippine turtle doves (and an inactive nest; Figs. 2 and 3, respectively) and a large monitor lizard (Varanus indicus; Fig. 8) were observed near to the site. These results (i.e., a remarkably obvious absence of birds) are consistent with current information for Guam (Savidge, in press; GAWRD personnel, personal communication). Data strongly indicates that the primary cause of the recent rapid decrease in bird populations on Guam has been predation by the introduced Philippine tree snake (Boiga irregularis; Savidge, in press).

Inventory of Species of Note

The following species were observed directly or their presence was inferred from evidence collected during the entire four days of fieldwork:

BIRDS:

Sulphur-crested cockatoo, Cacatua galerita:

A single cockatoo was seen in the study area, and is almost undoubtedly an escaped cage bird. The native range for this parrot is Australia, and the species is a common cage bird. The bird was observed along the road about 200 m north of dump site 2 on 17 July 1986. It appeared to be following or chasing two Mariana crows, and was in turn followed by two black drongos. The bird called as it flew, and I heard calls for several minutes after it disappeared coming from a short distance (<100 m) back in the forest. Guam DAWR personnel (R. Anderson et al., personal communication) remarked to me of their having seen an individual of this species in this area in previous years.

Philippine turtle dove, Streptopelia bitorquata (Fig. 2; nest: Fig 3):

This introduced species was seen on four occasions in the study area, mostly along or near to the road or the runways of Northwest Field. The tendency of these doves to sit on telephone wires might make them more conspicuous than other species, although Engbring and Ramsey (1984) considered them only fairly conspicuous. They are known to use both open and forested areas for feeding (Baker 1951), suggesting that all habitats in the study area can be

utilized by them. An unused or abandoned dove nest, most likely of this species, was found about 2 m up in a small tree adjacent to the runway next to the borrow pit site (see Fig. 1) in Northwest Field.

Black drongo, Dicrurus macrocercus (Fig. 4):

This introduced species was the most common bird in the study area, but was seen almost exclusively along the road or the runways of Northwest Field. Drongos often sit on telephone poles or wires and vocalize loudly and regularly. They are thus highly conspicuous (Engbring and Ramsey 1984), and these counts probably accurately assessed their status. The species is by no means abundant in the area, and has also suffered a decrease in abundance in recent years, although not to the extent of most of the native avifauna (Engbring and Ramsey 1984:42; G. Wiles, personal communication). In addition to being commonly seen on the road and borrow pit surveys (Table 1), three birds were seen at dump site 3 just prior to the station count period. Black drongos are mostly insectivorous and aggressively territorial. One individual along the road was seen hammering and then eating a large (8-10 cm) tettigoniid grasshopper. Drongos are known to mimic the vocalizations of other birds (Austin 1985), and were found giving calls similar to those of Micronesian kingfishers during the borrow pit survey.

Mariana crow, Corvus kubaryi (Fig. 5):

Mariana crows were documented on 8 occasions during the four days of fieldwork. They were seen or heard in several places, and in or over both habitat types within the study area. Because of the endangered status of the crow each observation is described here. On 15 July, one crow was heard calling about 10:30 near dump site 2 and was seen flying by shortly after. One or more crows was heard, but not seen, near dump site 3 later in the afternoon. I located an old and apparently unused crow nest in a large tree adjacent to the road (see Fig. 1). Prior to the first station count south of dump site 2 on 16 July a crow called four times as it flew over. A single crow was seen just prior to the station 5 count at dump site 3.

I saw two crows perched in a Pandanus about 200 m south of dump site 2 at 6:24 on 17 July. They flew after about 4 minutes in the tree. While walking along the road between playbacks I saw three crows fly from northwest field into the study area and then back and forth and back again during the next several minutes. During the third crossing of the road I saw the cockatoo noted above. On 19 July at about

7:00 I saw four crows at one time in Northwest Field close to the borrow pit. A short time later, along the road parallel to dump site 2, I saw four crows, perhaps the same birds as before. From these observations I suggest that there are at least four crows occupying the area between dump site 1 and 500 m north of dump site 2, and perhaps at least two crows occupying the area of dump site 3. I must stress that these numbers are minimal estimates in the absence of banded birds.

The Mariana Crow occupies forests almost exclusively (Baker 1951, Jenkins 1983, Engbring and Ramsey 1984), and is one of the few native forest birds that has appeared, at least recently, to be maintaining its populations in northern Guam (Engbring and Ramsey 1984:31). For the Northwest Field area and the Uruno basin (GAWRD census areas closest to the study area), Engbring and Ramsey (1984) estimated 4 and 6 birds per km2, respectively. The documentation of an unused crow nest, and observation of no apparent breeding activity at this time are consistent with the conclusion of Baker (1951) that nesting is confined to the winter and spring months. If the refuse removal is considered a threat to the breeding activities of the Mariana crow, perhaps the removal can be concentrated into the summer, non-breeding months. Crows are known to be quite sensitive to intrusion and noise near their nests (F. Duvall, personal communication).

MAMMALS:

Feral pig, Sus scrofa:

Only two observations involving feral pigs were made. The first was the sighting of damage probably caused by pigs during the initial survey of the site on 15 July. An area about 2 x 3 m just north of site 2 was largely devegetated and some tracks were depressed in the mud. The second observation was of a lone boar feeding in vegetation along the side of the main road near the beginning of the road leading to dump site 1. This boar was seen at about 06:00 on 16 July 1986. Overall, damage from pigs was not obvious within the study area.

Guam deer, Cervus unicolor:

A small pile of fresh deer spoor and a nearby matted sleeping area were discovered north of site 2 on 15 July and attributed to this introduced species. The Guam deer has been documented as being relatively common on AAFB (Wheeler 1979), and there is no reason not to expect them in the study area. No signs of vegetation damage were evident.

REPTILES:

Monitor lizard, Varanus indicus (Fig. 6):

Two observations of introduced monitor lizards were made. The first was found on 15 July 1986 along a small road leading in from the main road about 400 m north of dump site 2 (shown in the photograph in Fig. 6). The lizard was on the ground until it saw the members of our team, then climbed into a nearby tree in its escape. I estimate its total length was about 1.2 m. The second monitor was seen sunning near the edge of the runway adjacent to the borrow pit on 19 July, and was probably less than 1 m in length.

INVERTEBRATES:

African snail, Achatina fulica:

Shells of these introduced snails were found commonly throughout the study area. No live snails were noted. Some searching in the vicinity of each dump site for native tree and land snails was unsuccessful.

Garden spider, Argiope spp. (Fig. 7):

This was the most obvious invertebrate in the cliff forest station counts.

Inventory Based on Literature Records

The following list of species includes those which have been documented recently in or near the study area but are now extirpated and those which are known to occur on the study site because of recent literature records but were not documented during the fieldwork reported here. Vertebrate species of potential interest for the EIS are included (i.e., native and non-native land birds, seabirds, bats and Boiga).

The nine native forest birds listed below were all documented as having occurred in the Northwest Field censuses in 1978-1979 (Jenkins 1983) and in 1981 (Engbring and Ramsey 1984), and in the Uruno Basin censuses in 1981 (Engbring and Ramsey 1984). All of the species of native landbirds listed below except the rail, the kingfisher and the starling are now thought to be extirpated on Guam (GAWRD personnel, personal communication), probably as a result of predation by Boiga irregularis (Savidge, in press). Micronesian kingfishers were seen as recently as June 1986 in Northwest Field (GAWRD). Guam rails are still present in the flightline on AAFB, and I observed Micronesian starlings

(including two young birds) near the "Vietnam War Memorial" on AAFB on 19 July 1986. Only one introduced species other than the black drongo and the Philippine turtle dove was likely to have been found in the study area in the past: the chestnut mannikin (Lonchura malacca). Passer montanus is usually limited to areas of human habitation and disturbance (Engbring and Ramsey 1984).

Only one species of seabird has bred historically in the study area: the white (or fairy) tern (Gygis alba; GAWRD Annual Reports 1980, 1981). Brown noddys (Anous stolidus) are known to breed nearby in AAFB. I did not observe either species in the study area. I did observe a small number of white terns and brown noddys (and a single yellow bittern, Ixobrychus sinensis) in trees adjacent to the "Vietnam War Memorial" on AAFB on 19 July 1986. White terns, which lay their eggs on the branches of trees (Baker 1951), may have suffered a decline similar to the one that has occurred to native landbirds (GAWRD Annual Report 1981:133). No golden plovers (Pluvialis dominica) were observed during the study period; during fall through spring they are known to be common in the area (GAWRD Annual Report 1980, 1981).

Captive breeding of the Guam rail and the Micronesian kingfisher has been initiated at the Philadelphia, Bronx and Washington Zoos (Engbring and Ramsey 1984:1985 addendum), and has been relatively successful (GAWRD, personal communication). Reintroduction of these, and perhaps other species, may some day be carried out. Thus, despite the lack of birds at the present time, habitats should not be modified to the point that reintroduced species cannot utilize them.

BIRDS:

White (or fairy) tern, Gygis alba, indigenous.

Brown Noddy, Anous stolidus, indigenous.

Guam rail, Rallus owstoni, endemic species.

Micronesian kingfisher, Halcyon c. cinnamomina, indigenous.

Mariana fruit dove, Ptilinopus roseicapilla, indigenous.

White-throated ground dove, Gallicolumba x. xanthonura, indigenous.

Guam broadbill, Myiagra freycineti, endemic species.

Rufous-fronted fantail, Rhipidura rufifrons uraniae, endemic subspecies.

Micronesian starling, Aplonis opacus guami, indigenous.

Cardinal honeyeater, Myzomela cardinalis saffordi, indigenous.

Bridled white-eye, Zosterops c. conspicillata, endemic subspecies.

Chestnut mannikin, Lonchura malacca, introduced.

MAMMALS:

Marianas fruit bat, Pteropus mariannus: This indigenous bat occurred throughout Guam historically (Wheeler and Aguon 1978), but by the 1978 and 1984 surveys they no longer appeared to occur within the study area (Urono Point counts, Wheeler and Aguon 1978; Wiles, MS). Most of the recent bat sightings and observations of bat colonies occurred between Ritidian and Pati Points on the northeast shore (Wiles, MS), within 5-20 km of the study area. Despite this proximity, no fruit bats were recorded between Ritidian and Haputo Points during Wiles' 1984 surveys. No observations of bats were made during the survey reported herein, although on three of the four days of fieldwork I was at the study site at the optimal time for observing the bats (06:15 to 09:15, Wiles, MS). In addition, no obvious feeding sites (i.e., trees with mutilated fruits or leaves) were identified in the study area.

REPTILES:

Phillipine rat snake, Boiga irregularis: This introduced snake occurs throughout Guam at the present time (Savidge, in press). They were trapped commonly in the nearby Ritidian area, and thus are likely to be common on the study area as well (Wiles, personal communication). No snakes were seen on the study area, but their nocturnal and arboreal habits make it unlikely that any would have been seen during the times in which the surveys were conducted.

Conclusions and Recommendations

Relatively few birds were observed during the fieldwork. The populations of birds and of some other wildlife species were extremely low in the study area in comparison to similar habitats in other parts of the world (personal judgement). These results, however, are identical to expectations from recent literature and communications concerning Guam's native wildlife (Wheeler and Aguon 1978; Jenkins 1983; Engbring and Ramsey 1984; Savidge 1984, in press; Wiles, MS). The rapid decline and eventual extinction of most or all of the species has been most clearly attributed to nest predation and adult mortality caused by the Philippine tree snake (Savidge, in press).

The most abundant vertebrates in the study area appeared to be forest dwelling skinks. I believe that these skink densities are abnormally high. In addition, spiders of the genus Argiope appeared to be exceptionally abundant. I suggest that these high densities may represent a response to the lack of birds, either through escape from predation or competition.

The only native bird species found in the study area was the endangered Mariana crow. The Mariana crow population appears not to have declined quite as rapidly as populations of other species (Enbring and Ramsey 1984), probably because the adults are too large to be depredated by the snake. However, the crow is in danger of extinction, and I suggest that efforts be made to ensure that the proposed cleanup does not in some way hinder the breeding of the birds. The birds breed in the winter and spring months (Baker 1951), and may be sensitive to the noise of heavy machinery operating while they are nesting. Hawaiian crows (Corvus tropicus) are very sensitive to noises and human intrusion while nesting (F. Duvall, personal communication). Limiting the intrusiveness of the machinery involved should be a consideration of the planners.

In addition to the Mariana crow, nine species of native forest birds once occupied the study area and its surroundings (Baker 1951, Jenkins 1983). Despite the extinction of several of these Guamanian forms, populations from other islands, or captive-bred populations, may be re-introduced at some point in the future when the snake and other sources of mortality can be controlled. Thus, the habitats in the study area should be altered as little as possible during the cleanup process. The primary habitat that would be used by these reintroduced native birds is the mature limestone forest (Jenkins 1983). Because the dump sites do not occupy such habitats, little damage would occur

if the cleanup activities are restricted mostly to the dump sites (i.e., second growth habitat). In addition, the damage caused to the habitat by the dumping might be repaired by reforestation of the dump sites with native vegetation following the cleanup.

Little damage from introduced, herbivorous mammals was documented. Although I saw a feral pig, and found areas where both pig and deer had occurred, the damage to the vegetation and soil seemed far less than many areas I have observed in Hawaii.

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Table 1. List of animal species of interest (i.e., vertebrates and selected invertebrates) found on the site, and results of the surveys. These include the number of species documented from the station survey, the two road surveys, and the borrow pit survey. See species inventory accounts in the text for information on observations made outside of surveys.

Species	Number Documented in Survey: Station	Road	Borrow
BIRDS:			
Sulphur-crested Cockatoo (*Cacatua galerita*)	0	0,0	0
Philippine Turtle Dove (*Streptopelia bitorquata*)	0	1,2	4
Black Drongo (*Dicrurus macrocercus*)	0*	2,3	10
Mariana Crow (*Corvus kubaryi*)	0*	0,4	4
MAMMALS:			
Feral Pig (*Sus scrofa*)	0*	0,0	0
Guam Deer (*Cervus unicolor*)	0*	0,0	0
REPTILES:			
Monitor Lizard (*Varanus indicus*)	0*	0,0	1
Skink (species)	9	0,0	2-3
AMPHIBIANS:			
Marine Toad (*Bufo marinus*)	0	2,2	1
INVERTEBRATES (of note):			

African Snail (Achatina fulica)	>10*	0,0	0
Garden Spiders (Argiope spp.)	>10	0,0	0

*One or more individuals was seen in the area covered by the transect either prior to the survey or between stations.

'Animals were found dead only.

Figure 1. Map of study area. Shows the three dump sites, station census transect, road survey transect, and the borrow pit survey route. Study area is Artero property and adjacent Anderson Air Force Base, Guam.

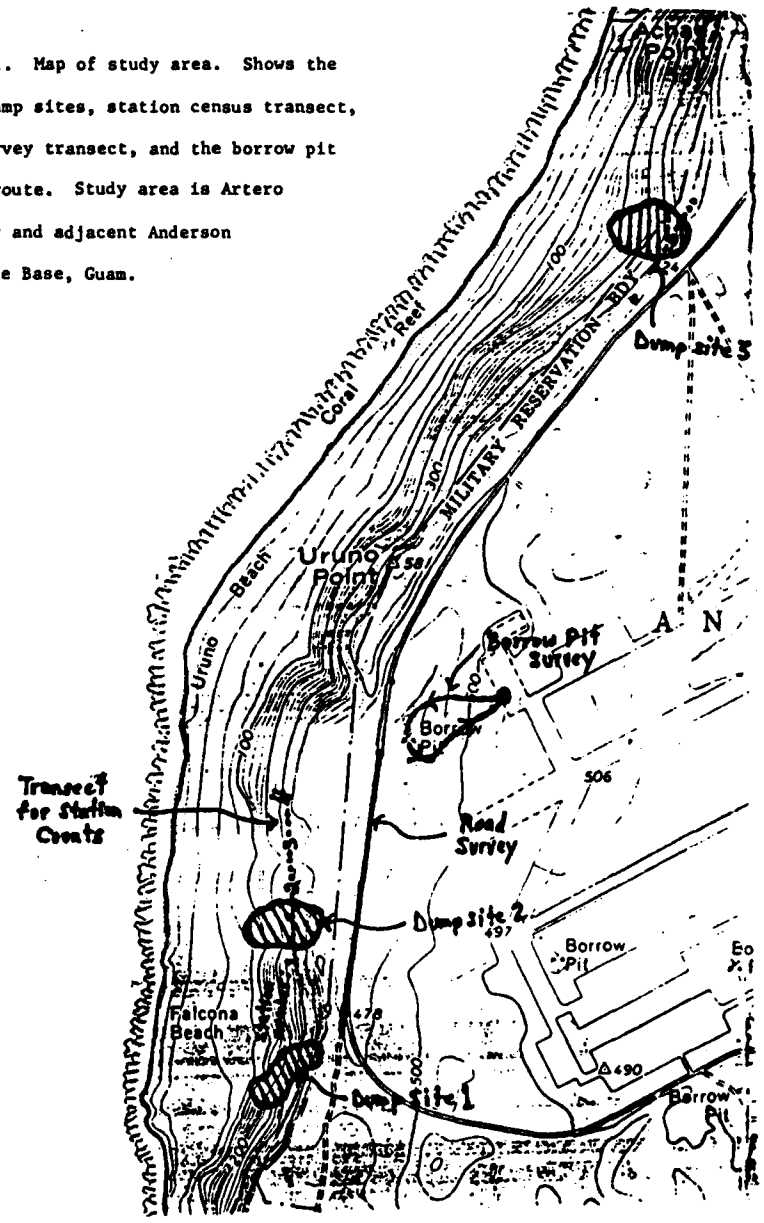

Figure 2. Philippine Turtle Dove, Streptopelia bitorquata. Photo by R. C. Fleischer.

Figure 3. Probable nest of Philli-pine Turtle Dove. Photo taken at edge of runway opposite borrow pit in Northwest Field, AAFB, Guam by R. C. Fleischer.

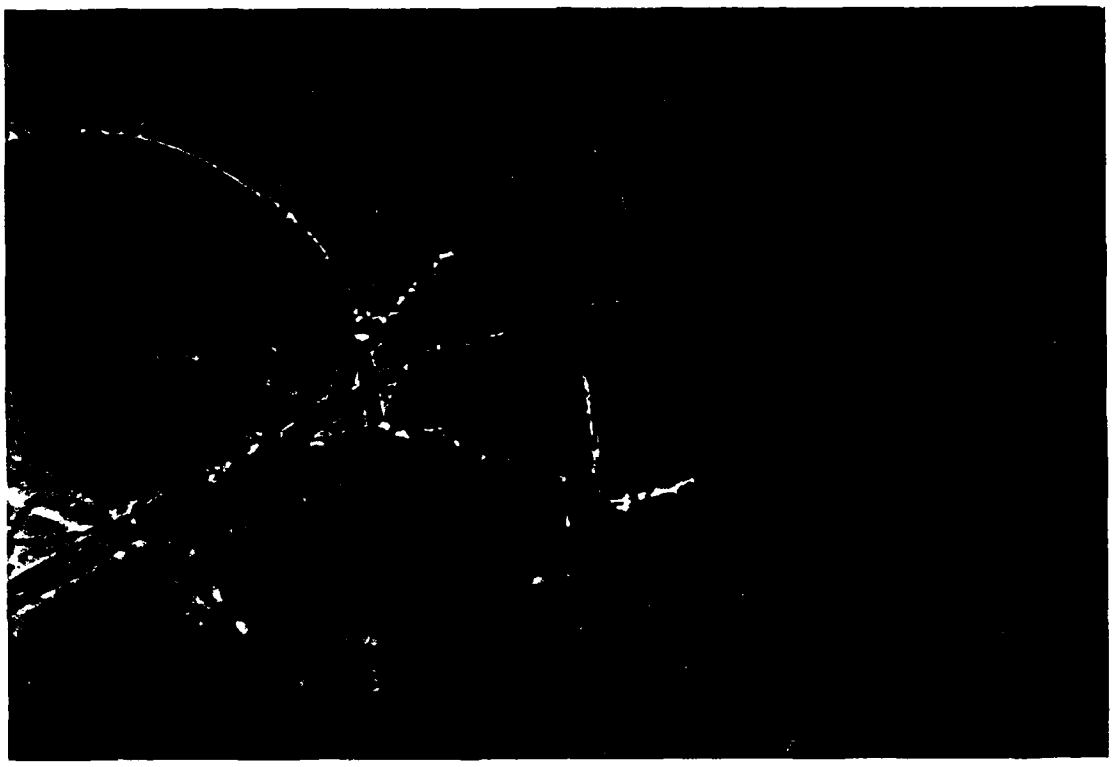

Figure 4. Black Drongo, Dicrurus macrocercus. Photo from Division of Aquatic & Wildlife Resources, Government of Guam, by Anne Maben.

Figure 5. Marianas Crow, Corvus kubaryi. Photo from Division of Aquatic & Wildlife Resources, Government of Guam, by Anne Maben.

Figure 6. Monitor lizard, Varanus indicus. Photo taken in study area about 400 m north of dump site 2 (see Fig. 1). Monitor is estimated at 1.2 m in total length.

APPENDIX F

A CANDIDATE MARINE ENVIRONMENTAL IMPACT SURVEY FOR THE POTENTIAL DEVELOPMENT OF THE URUNO POINT REEF AREA ON GUAM, MARIANA ISLANDS

By

Richard E. Dickinson and Roy T. Tsuda

A CONTRACT REPORT

Prepared for

AUSTIN, SMITH AND ASSOCIATES, INC.

As per

MEMORANDUM OF UNDERSTANDING AND AGREEMENT

SIGNED ON MARCH 14, 1975

Technical Report No. 19

University of Guam Marine Laboratory

April 1975

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INTRODUCTION

Background

The Uruno Point area is at present a beautiful, completely unspoiled and relatively inaccessible coastline (ca. 2 mi. long) located on the northwest side of Guam (Fig. 1). Within the last two years, there has been much discussion for the development of a beach resort in this area. It has also been proposed that monies in excess of $50 million will be spent in the proposed Uruno Beach Resort Development for construction of hotels, restaurants, marina, aquarium, and a botanical garden.

A letter dated August 31, 1973 from Mr. William A. McAlister (President, T. J. Davis, Inc.) to Dr. William V. Vitarelli (Vice-President of Research and Special Projects, University of Guam) provides a glimpse into the proposed development.

> "It is the intent of the developers to retain and add to the natural beauty in order that the complex will present a unique, tropical, natural resort area with particular emphasis on the Chamorro culture, native flora and fauna, and the marine life in the waters adjacent to the beach area."

The fact that Marine Laboratory personnel were involved in the marine survey does not constitute an endorsement of the proposed Uruno Beach Resort Development Project by the authors, the Marine Laboratory, or the University of Guam. We felt the study was necessary and have approached all aspects in an unbiased manner. All opinions expressed herein are those of the authors.

Although the University of Guam Marine Laboratory has been participating in discussion on the environmental aspects of the proposed Uruno Resort Development since August 31, 1973, the final affirmative step of the Marine Laboratory's participation in this study was negotiated on March 14, 1975 in a Memorandum of Understanding and Agreement between Austin, Smith, and Associates, Inc. and the University of Guam.

Scope of Work

The Marine Laboratory was given a month to both complete the following studies and submit its findings and recommendations.

1. Prepare a biological survey for the development including:
   - A. Construction of three swimming pools on the reef flat.
   - B. Construction of a marina.
   - C. Construction of sewage outfall for discharge of secondary treated effluent at -60 feet.
2. Perform current studies (two 24-hour studies).

Personnel

Since time was limited, a large work force comprised of graduate students, undergraduate students, and marine technicians was mobilized to undertake the field work. Roy T. Tsuda, Ph.D., Director of the Marine Laboratory, served as Principal Investigator and Richard E. Dickinson, M.S. candidate in Biology, Marine Laboratory, served as the Student Project Leader. The actual report writing fell on these two individuals.

The students who contributed to the study were as follows: Gerald A. Heslinga, Visiting Undergraduate from Harvard University; William J. Zolan, James E. Doty, Ronald D. Strong, Daniel S. Wooster, and William J. Tobias, all M.S. Candidates in Biology, *University of* Guam Marine Laboratory.

Marine technicians Frank Cushing and Pat Beeman, Marine Laboratory, also contributed their experience in the offshore current studies.

During certain stages of the project, specialists were asked to provide names to the multitude of reef organisms found in the study area. Dr. Steven S. Amesbury, Agricultural Experiment Station, University of Guam, provided us a checklist of fishes found on the reef flat; Dr. Frank Rowe, Australian Museum, provided us a checklist and quantitative information on the holothurians (sea cucumbers) present on the reef flat; and Dr. Masashi Yamaguchi, Marine Laboratory, University of Guam, identified the scleractinian corals collected from the area.

GENERAL DESCRIPTION OF REEF ZONES

Shoreline

The beach from Achae Point to just south of Falcona Beach is roughly 10-15 m wide, extending from the dense vegetation zone down a 30° slope to the ocean. The beach is composed mostly of unconsolidated bioclastic deposits of mollusc shells, foraminifera tests, and coral sand, similar to that described by Jones and Randall (1973) for an unconsolidated beach. The shoreline is interrupted by two small rocky headlands between Uruno Point and Falcona Beach. Remnant patches of raised limestone are also scattered along the shore.

Inner Reef Flat

The inner reef flat is roughly 10-15 m wide and consists of bioclastic beach deposits, mostly Acropora rubble, mollusc shells, foramnifera, and coral sand. The moat system is shallow, between 1-1.5 m deep and poorly developed. There are numerous small freshwater rivulets, especially noticeable at low tide, running from the shore, and rocky headlands into the moat and there is an apparent layer of freshwater on the surface in many places.

Outer Reef Flat

The outer reef flat varies from 50 m to 100 m wide and has numerous scattered patches of exposed limestone. In deeper areas the substrate is covered by the staghorn coral, Acropora hebes. This coral forms dense, flat-topped thickets which grow upward to the low tide line and comprise the principal structure on the outer reef flat. Additionally, massive Porites microatolls can be found in the deeper pools and are scattered along the reef flat. There are large deposits of broken

Acropora branches and other coral debris creating small patches of sand-rubble substrata.

Randall and Holloman (1974) provides a general description of the reef flat and offshore zones.

> "A narrow cuesta-type of algal ridge forms an elevated hummocky region at the reef margin. This ridge is solid and massive and is cut by short shallow surge channels. There is no room-and-pillar development at the reef margin and reef front zone comparable to that found on the southeast side of Ritidian Channel. The reef front is cut by a groove-and-spur system along most of the section, although at some locations considerable development of coral-algal knobs and bosses is taking place on the upper surfaces of spurs. The reef front appears to be somewhat in equilibrium as far as outward growth and erosion are concerned. The 55-foot submarine terrace is present along most of the section, but it is narrow and irregular. At some places there seem to be relic features such as grooves and channels at the seaward margin of the terrace which resemble a sunken reef-margin system.
>
> The outer part of the reef front, submarine terrace, and seaward slope zone was heavily infested by Acanthaster planci in 1969 along this entire sector. Most of the reef-building corals were killed in all three fringing reef zones as a result of predation by

these starfish. Wave and surf action prevented intensive starfish damage in the reef margin and inner part of the reef front zones Rich coral growth is more or less restricted to this narrow wave-assaulted region at the present time. Recent surveys show that recolonization of the dead coralla surface by calcareous red algae in the reef front zone has maintained the structural integrity of the colonies. New coral growth from planula settlement and small patches which survived the initial starfish predation was also evident in the affected zones during this survey."

METHODOLOGY

Water Circulation Studies

In an effort to obtain a general idea of the water movements over the reef flat and the current patterns off-shore, dye and drogue studies were conducted in the study area. Fluorescein dye was released over the inner and outer reef flat zones along each of the four reef flat transects (Fig. 2) during periods of high tide (April 5) and low tide (April 10). The water was flooding from 1.5 to 1.0 feet during the high tide study and ebbing from about .9 to .5 feet during the low tide study. The velocity of the water movement was obtained by measuring the dye patch movement per unit time (m/sec.) and the direction relative to shore was recorded. The speed and direction of the wind during each drop was also recorded.

The original proposal for the off-shore current studies was to carry out 24-hour drogue studies at two sites - one station north of Uruno Point and the other station south of the Point. However, we were forced to resort to an alternative plan of only conducting studies during the daylight hours on two days, April 11 (0830-1700) and 12 (0930-1700). The uncompleted status of our negotiations (March 7-8) with the contractors, heavy seas (April 4-5), and the lack of a larger boat for overnight studies (April 11-12) forced us to carry out the alternative plan.

Thus, on April 11-12, pairs of drogues (1 m and 5 m) were cast at each of two stations both marked by buoys. Station 1 was located north of Uruno Point about 130 m from the reef margin, while Station 2 was located south of the Point about 170 m from the reef margin.

Both stations were located in water over 60 feet deep. The direction and the distance traveled by the drogues were recorded each hour. In most cases, the pair of drogues were left to drift for two hours and then recast at their respective stations. Wind speed and direction were also recorded.

Biological Studies

Transects (Fig. 2) were established along the reef flat and off-shore to facilitate quantitative study of corals, algae, and holothurians and to provide a metered line for bottom profiles (Figs. 3-4).

The reef flat transects (1-4) were located perpendicular to shore and extended 70-80 m toward the reef margin. The selection of the transect sites was based on a desire to assess the reef flat at potential marina and swimming areas; therefore, obstructed zones and rocky headlands were deliberately avoided.

The offshore transects, 5 & 6, were located perpendicular to the 60 foot terrace edge and extending 100 m toward the margin. The sites were chosen to provide data from both the more exposed windward reef north of Uruno Point and the more protected reef south of the point.

In addition the transect was used as a guide for the bottom profiles (Fig. 5).

Algae

The macroalgal community was quantified by a modified point method (Tsuda, 1972) utilizing a 25 cm x 25 cm quadrat randomly tossed 10 times in the inner reef flat, the outer reef flat and the reef margin. These tosses were made along Transects 1-4. The reef margin, however, was only sampled on Transects 1 and 2. Twenty-two tosses

were made along the reef terrace, two per every 10 m distance.

The quadrat frame was divided into a grid of 25 squares, each 5 cm x 5 cm, providing 16 interior "points" where the grid lines intersected. Each algal species was recorded at every "point" it occurred. If no alga was found under any of the "points" then whatever was present, e.g., sand, live coral, dead coral, was recorded. From this data, relative abundance and frequency were calculated for each species in their respective zones and transects. The percent algal cover in relationship to the amount of sand, live coral and dead coral, was calculated by considering every item recorded for all "points".

$$\text{Relative Abundance} = \frac{\text{No. of Points per Species}}{\text{No. of Points all Species}} \times 100$$

$$\text{Frequency} = \frac{\text{No. of Tosses a Particular Species Occurred}}{\text{Total No. of Tosses}} \times 100$$

All algal species seen in the various zones, i.e., inner reef flat, outer reef flat, reef margin, reef front, reef terrace and reef slope, were recorded.

Corals

Ten random tosses utilizing a 50 cm x 50 cm quadrat were made in the inner reef flat and the outer reef flat on all four reef flat transects. The modified point methods, similar to that used in the algal study, was used to obtain relative abundance, frequency, and percent coverage. This method differs from that used for quantifying the reef terrace corals because corals are more widely distributed on the reef flat and the point quarter method would not be practical.

The point quarter method (Cottam et al., 1953) was used in quantifying the corals on Transects 5 & 6 on the reef terrace. A series of points, 10 m

apart, were selected from the transect line and the area around each transect was divided into four equal quadrants. The coral nearest the transect point in each quadrant was located and its specific or generic name, diameter, and the distance from the center of the corallum to the transect point was recorded. Total coral density, frequency, and relative density were then determined from the above data.

$$\text{Total Density of All Species} = \frac{\text{Unit area}}{(\text{mean point-to-coral distance})^2}$$

$$\text{Relative Density} = \frac{\text{individuals of a species}}{\text{total individuals of all species}} \times 100$$

$$\text{Frequency} = \frac{\text{number of points at which species occurs}}{\text{total number of points sampled}} \times 100$$

In addition, a general collection of corals was made from the zones in the study area.

Fishes

Fishes were surveyed at three areas along the reef flat (Transects 1, 2, and 4). Two environmental zones, the inner reef flat with a substrate made up of sand with scattered limestone boulders and the outer reef flat with a substrate of limestone pavement and Acropora beds, were separately inventoried. Surveys were made by snorkeling in a meandering pattern for about 15 minutes through the zone under investigation.

RESULTS AND DISCUSSION

Water Circulation Studies

Reef Flat Water Movement

The dye studies carried out during high tide showed a northeasterly movement, parallel to shore (Figs. 6-9) at all transects. The inner reef flat zones showed stronger movement at Transects 1, 2, and 4. Water movement over the inner and outer reef flats at Transect 3 was relatively similar, with movement over the outer reef flat slightly faster. The dye at Transect 4 moved northeasterly and then exited at a rocky headland approximately 200 m northeast of the drop site. This outcrop diverts the water and is hazardous, especially during high tide, when volume transport is greatest.

The dye studies on April 5 were conducted during high surfs (5-7 feet) causing high turbulence which, in turn, increased the rate of water movement. In general, the dye studies indicate strong along shore movement, especially during high tides and heavy surf, creating hazardous swimming conditions as close as 30 feet from shore.

The low tide dye studies (Figs. 10-13) showed considerably less movement than during high tides. There was no movement of water at Transect 1 and the dye was visible for over one hour. With the exception of the dye patch dropped at Transect 2, water moved in a northeasterly direction parallel to shore. At Transect 2, the water moved in a southerly direction towards shore. The slow movement is primarily caused by the minimal drainage during low tides when extensive sections of the reef are exposed.

Offshore Currents

Drogue studies were conducted 1, 3, and 5 miles north of Ritidian Point by the Navy Oceanographic Office (Huddell et al., 1974) on February 24, 1971 and August 26, 1971. They state that "During February surface currents appeared to be relatively weaker; no movement at all was observed 5 miles (8 km) north of the point. Currents within a mile of Ritidian Point showed a more easterly component during both winter and summer than the currents further from shore. Surface currents north of Ritidian Point flowed against the prevailing winds and opposite to the North Equatorial Current as shown in both the current meter data and drogue trancking".

Our offshore current studied (Figs. 14 and 15) indicate a general southwesterly flow except for the morning drogues which moved north from both stations on the two days. Most drogues in our study were affected by the wind. The more protected location of Station 2 (south of Uruno Point) probably accounts for the slower movement of these drogues as opposed to the northern drogues which moved in excess of 1 knot in one instance. None of the drogues ran aground on the reef, however, those from Station 1 traveled closely parallel to the reef margin.

The prevalent southwesterly trend follows the theory (Emery, 1962) that the North Equatorial Current splits northeast of Guam and continues south along the eastern and western sides to converge southwest of Guam. However, the Navy's study at Ritidian seems to contradict this.

In trying to correlate the perculiar northerly drifts with the tidal cycle (since the drogues were moving against the prevailing wind),

it appears that this northerly current exists approximately four hours out-of-phase with the tidal cycle. Our study included the hours when the tide was at its lowest point(Fig. 16), Further current studies should be made to include the hours when the tide in at its peak to see if a northerly current develops.

Water Movement At 50 Feet Depth

Dye was released in 50 feet of water at both Stations 5 and 6. The dye patch on Transect 5 moved seaward and diffused down the reef slope, while the dye patch on Transect 6 moved inshore toward the reef margin.

Biological Studies

Table 1 lists the 56 species of marine benthic algae, thus far, collected or observed in the six reef zones at the Uruno Point study area. This listing must be considered preliminary since collections and observations were carried out on only four days. Table 2 presents the relative abundance, frequency, and algal cover of the predominant algae in four - inner reef flat, outer reef flat, reef margin, and reef terrace-of the six reef zones.

The dominant algae on the inner reef flat are Cladophoropsis membranacea, Jania capillacea, Gelidiella acerosa, and Jania capillacea; the dominant algae on the outer reef flat are Microdictyon okamurai, Boodlea composita, and Polysiphonia sp. Turbinaria ornata is the obvious algae on the reef margin which is comprised predominantly of Porolithon onkodes. In those areas of the reef which possesses a distinctly raised reef margin, a golden-colored species of Gelidium is dominant.

The reef front is dorinated by the larger algae, e.g., Halymenia durvillaei, Galaxaura oblongata, and Galaxaura marginata. Tolypiocladia glomerulata is the dominant alga on the reef terrace along both Transects 5 and 6. Halimeda discoidea is distributed sparsely on the reef slope which is covered with coralline algae.

When the benthic algae are considered as a whole, the turf community is by far the most dominant and seem to be in ample abundance to serve as food for the herbivorous fish population on the reef terrace.

Corals

Table 3 lists the species of corals collected or observed in three reef zones at the Uruno Point study area. The list is not complete since only three of the six reef zones were sampled. Table 4 shows the relative abundance, frequency and percent coverage for the inner and outer reef flat corals and Table 5 presents the relative density, frequency, and total density for the reef terrace corals.

Small branches of Acropora hebes and a few small Porites colonies comprise most of the living coral in the inner reef flat. This zone is mostly rubble and sand. The dominant coral on the outer reef flat is Acropora hebes where colonies form extensive thickets. The other more common species are Goniastrea retiformis, Pocillopora damicornis, and Psammocora contigua. The flat elevated limestone areas were devoid of coral and are mostly a sand-algal cover.

The reef terrace is sparsely populated with live coral. The predominant coral is an encrusting Montipora conicula. Another encrusting form, Montipora tuberculosa is also common. These two corals form broad encrusting patches on the substrata and are vividly colored

blue and red in their natural state. Other common corals are Favia pallida, Platygyra rustica, Porites lichen, and Pocillopora sp.

The reef terrace experienced heavy Acanthaster planci predation (Chesher 1969, Tsuda, 1971) and numerous dead coral colonies are evident.

Fishes

The reef flat area of Uruno Point contains a varied assemblage of typical tropical reef fish species (Table 6). Tourist-oriented development in this area should take advantage of this very accessible "natural aquarium" by preserving it for the enjoyment of snorklers and divers. The opportunity to observe such colorful fishes as the butterflyfishes (Chaetodontidae), damselfishes (Pomacentridae), surgeonfishes (Acanthuridae) and triggerfishes (Rhinecanthus rectangularis, the well-known "humuhumu-nukunuku-a-pua'a" of Hawaii) in their natural setting could develop into a considerable tourist attraction.

Holothurians

Table 7 includes a list of the holothurians found in the study area. Holothuria (Halodeima) atra is the dominant holothurian of the inner reef flat. It is typically found on, but not restricted to, sandy areas. The second most visually dominant holothurian is Stichopus chloronotus, which seems to be more abundnat here than on other reef flats. S. chloronotus is restricted to solid substrates and is generally more abundant in the outer reef flat.

The relatively inconspicuous Holothuria (Platyperona) difficilis was found associated with thickets of dead Acropora hebes in the outer

reef flat of Transect 3. In these areas it is the most numerous holothurian - reaching estimated concentrations of over 75 individuals per 10 m^2. Precise counts were not possible at the time of the survey, however, these holothurians are quite interesting in that their distribution seemed very distinct (Figs. 17 and 18). This may indicate narrow habitat requirements for this organism.

Bohadschia bivittata and B. argus are present in moderate numbers in the sandy areas. These species are notable for their irritability and habit of releasing sticky cuvarian organs at the slightest disturbance. This has been known to cause annoyance to swimmers and waders. Actinopyga echinites and the large Holothuria (Microthele) nobilis are also present in moderate numbers.

Finally, one specimen each of Holothuria (Semperothuria) cinerascens and Holothuria (Thymiosycia) hilla were collected. Notably, no synaptids were seen., These are common on reefs elsewhere on Guam.

Other Macroinvertebrates

A checklist of the other common macroinvertebrates can be found in Table 7.

CONCLUSIONS

The reef flat of the study area does not have an extensive moat system nor did we notice any exceptionally deep areas. The deepest water is within 35 meters of shore and averages 4-5 feet at MHHW. Dye studies indicate strong reef flat currents during high tides and especially when influenced by high surf. At such times, swimming would be hazardous.

The outer reef flat is not particularly rich in coral growth and snorkelling would be possible only at high tide when conditions are hazardous. Additionally, no broad sandy areas were noted and the substrate has much coral debris, thus requiring footwear for snorkellers or reef walking.

There are no natural coves in the study area and a marina is not feasible without extensive dredging of the reef flat and construction of a retaining wall for added protection.

The offshore current studies showed a consistent west southwest drift with the notable exception of a northerly drift for morning drogues. Drogues from Station 1 moved faster probably due to their more exposed location and were greatly influenced by the wind.

The water directly off Uruno Point is considerably rougher than north toward Achae Point or south to Falcona Beach. We believe currents sweeping down from the north are forced offshore at Uruno Point.

The reef structure between areas north and south of Uruno Point are markedly different. The northern (Transect 5) reef terrace is considerably narrower than that of the south and the reef front is

characterized mostly by a groove and spur development. The southern reef terrace (Transect 6) is broad and has numerous wide surge channels and is pocketed with coves and steep pinnacles providing beautiful SCUBA diving. Underwater trails would be ideal here.

Dye patches released at 50 foot depth on the terrace of both stations also differed. Station 1 dye patch moved seaward and diffused down the reef slope while dye from Station 2 moved directly shoreward.

The Uruno Point study area includes the most extensive stretch of undisturbed beach on Guam. Because the area has been inaccessible in the past it retains a virtually undisturbed environment and any alteration must be carefully evaluated to ensure minimal changes to its natural beauty.

RECOMMENDATIONS

A candidate environmental impact survey of the marine environment conducted within a 30-day period is obviously piecemeal since it does not consider the seasonal variation of the organisms and the variable current patterns during a yearly cycle. Thus, the following recommendations which are the results of discussions among project participants must be accepted with caution.

1. If swimming holes must be dredged, they should be located in the deeper moat areas of the inner reef flat within 30 to 40 m from shore. Although the dye studies on the inner reef of the southern side of Uruno Point show greater water movement, these swimming holes should be situated on this more protected side. When the exact locations of the swimming holes are pinpointed, further dye studies should be carried out at each side.
2. It is not feasible to construct a marina on the reef flat. The construction of an inland marina connnected by a channel through the reef flat is the better alternative. This again should be located south of Uruno Point as tentatively planned.
3. Based on the limited offshore current studies, the most suitable location to release the sewage effluent seems to be directly off Uruno Point. We further recommend that the effluent be released through multiple diffusers on the reef slope which lies in about 60 feet of water.

Engineering studies will no doubt cite this depth as too excessive if the sewerage is to be secondarily treated. However, a safety measure must be included in case the treatment plant malfunctions, thus, by-passing raw sewage into the nearshore waters. Further drogue studies must be carried out over the reef slope directly off Uruno Point at different times of year.

4. Rigorous control over exploitation of reef resources, e.g., fishes, lobsters, and shells, must be established to preserve the natural environment since easy access to this once relatively inaccessible area will be provided if this Resort Development becomes a reality. These controls should not be enforced on those traditional fishermen who have always fished in this area.

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Table 1. Checklist of marine algae recorded from the Uruno Point study area.

Species	Inner Reef Flat	Outer Reef Flat	Reef Margin	Reef Front	Reef Terrace	Reef Slope
CYANOPHYTA (blue-green algae) - 3 spp.						
Microcoleus lyngbyaceus (Kutz.) Crouan		X		X	X	X
Schizothrix calcicola (Ag.) Gomont	X	X	X	X	X	X
Schizothrix mexicana Gomont		X	X		X	
CHLOROPHYTA (green algae) - 20 spp.						
Boergesenia forbesii (Harv.) Feldmann	X	X				
Boodlea composita (Harv.) Brand	X	X				
Caulerpa antoensis Yamada	X	X		X	X	
Caulerpa racemosa (Forskal) J. Ag.		X		X		
Caulerpa serrulata (Forskal) J. Ag.	X	X	X			
Chlorodesmis fastigiata (C. Ag.) Ducker		X	X	X		
Cladophoropsis membranacea (Ag.) Boerg.	X	X				
Dictyosphaeria cavernosa (Forskal) Boerg.	X	X		X	X	
Dictyosphaeria versluysii W. v. Bosse	X				X	
Enteromorpha clathrata (Roth) Ag.	X					
Halimeda copiosa Goreau & Graham						X
Halimeda discoidea Decaisne			X	X	X	X
Halimeda incrassata (Ellis) Lamx.						X
Halimeda opuntia (L.) Lamx.	X	X	X		X	X
Microdictyon okamurai Setch.	X	X	X			
Neomeris annulata Dickie		X		X	X	
Neomeris vanbosseae Howe	X	X		X	X	
Valonia aegagropila C. Ag.	X	X				
Valonia ventricosa J. Ag.		X		X	X	
Valoniopsis pachynema (Martens) Boerg.		X				
PHAEOPHYTA (brown algae) - 10 spp.						
Dictyota bartayresii Lamx.		X				
Dictyota friabilis Setch.				X	X	
Feldmannia indica (Sonder) Womers. & Bailey		X			X	

Table 1. (continued)

Species	Inner Reef Flat	Outer Reef Flat	Reef Margin	Reef Front	Reef Terrace	Reef Slope
Lobophora variegata (Lamx.) Womers.	X	X	X	X	X	X
Padina jonesii Tsuda				X	X	X
Padina minor Yamada	X	X				
Ralfsia pangoensis Setch.	X					
Sargassum cristaefolium C. Ag.		X	X			
Sphacelaria tribuloides Meneghini		X		X	X	
Turbinaria ornata (Turner) J. Ag.	X	X	X	X		
RHODOPHYTA (red algae) - 23 spp.						
Actinotrichia fragilis (Forskal) Boerg.				X		
Amphiroa fragilissima (L.) Lamx.	X			X	X	
Champia parvula (C. Ag.) Harvey		X				
Chondria sp.					X	
Dasyphila plumarioides Yendo				X		
Desmia hornemanni Lyngbye				X		
Galaxaura filamentosa Chou		X				
Galaxaura marginata Lamx.	X	X		X		
Galaxaura oblongata (E. & S.) Lamx.		X		X		
Gelidiella acerosa (Forskal) Feldm. & Hamel	X	X	X			
Gelidiopsis intricata (Ag.) Vickers		X	X			
Gelidium pusillum (Stackh.) Le Jolis	X	X			X	X
Gelidium sp.			X			
Halymenia durvillaei Bory				X		
Hypnea cervicornis J. Ag.	X	X		X	X	
Jania capillacea Harvey	X	X	X	X	X	
Leveillea jungermannioides Harvey		X	X			
Liagora sp.				X		
Polysiphonia sp.	X	X	X	X	X	

Table 1. (continued)

Species	Inner Reef Flat	Outer Reef Flat	Reef Margin	Reef Front	Reef Terrace	Reef Slope
Porolithon onkodes Foslie	X	X	X	X	X	X
Rhodymenia sp.		X		X		
Trichogloea sp.						
Tolypiocladia glomerulata (Ag.) Schmitz & Hauptfleisch				X	X	
Total Number of Species Per Zone	25	38	17	29	24	10

Table 2. Relative abundance (RA) and frequency (F) of the benthic algae quantified on the inner reef flat, outer reef flat, reef margin, and reef terrace based on six transects at the Uruno Point study area. See Fig. 2 for locations of Transects 1 - 6.

Species	Transects 1 RA	1 F	2 RA	2 F	3 RA	3 F	4 RA	4 F
			INNER REEF FLAT					
CYANOPHYTA								
Schizothrix calcicola					5	20		
CHLOROPHYTA							23	70
Boergesenia forbesii					19	40	14	30
Caulerpa entoensis	10	30	5	20	5	10		
Caulerpa serrulata	20	20					5	20
Cladophoropsis membranacea	6	10					7	20
Enteromorpha clathrata	12	30	4	20				
Halimeda opuntia	4	20			1	10		
Microdictyon okamurai								
Neomeris vanbosseae	8	40	1	10				
Valonia aegagropila								
PHAEOPHYTA								
Lobophora variegata	4	20	16	60	1	10	1	10
Padina minor							1	10
Palisia panamaensis					1	10		
Turbinaria ornata	4	30						
RHODOPHYTA								
Galaxaura oblongata					1	10	10	30
Galidiella acerosa			4	20	65	80		
Gelidium pusillum							3	20
Jania capillacea	14	50	61	60			30	60
Polysiphonia sp.	6	10	4	20	2	10		
Porolithon onkodes	12	60	6	40			6	30
Algal Cover (%)	48		58		63		80	

Table 2. (continued)

Species	Transects 1 RA	1 F	2 RA	2 F	3 RA	3 F	4 RA	4 F
			OUTER REEF FLAT					
CYANOPHYTA								
Schizothrix calcicola	1	10			9	30		
CHLOROPHYTA								
Boergesenia forbesii					1	10		
Boodlea composita					14	30		
Caulerpa antoensis	1	10			5	10	24	40
Caulerpa serrulata	7	30	6	20				
Cladophoropsis membranacea	8	40	3	20			23	20
Halimeda opuntia	6	40	2	20	12	40	4	10
Microdictyon okamurai	56	100	41				18	40
Neomeris vanbosseae					2	20		
Valonia aegagropila	4	30	3	40				
PHAEOPHYTA								
Padina minor							2	20
Turbinaria ornata	2	70	2	20				
RHODOPHYTA								
Gelidiella acerosa			22	60	20	30	9	20
Gelidium pusillum	2	20					6	10
Jania capillacea			19	50			10	20
Polysiphonia sp.					37	50		
Porolithon onkodes	3	30	2	30			4	30
Algal Cover (%)	63		81		69		73	

Table 2. (continued)

Species	Transects 1 RA	1 F	2 RA	2 F
	REEF MARGIN			
CYANOPHYTA				
Schizothrix calcicola	9	10		
Schizothrix mexicana			1	10
CHLOROPHYTA				
Caulerpa serrulata	3	20		
Halimeda ounitia			5	20
Microdictyon okamurai			19	60
PHAEOPHYTA				
Lobophora variegata			1	10
Turbinaria ornata	65	80	13	60
RHODOPHYTA				
Gelidiella acerosa			3	10
Gelidiopsis intricata			7	20
Jania capillacea	18	40	15	20
Polysiphonia sp.			33	40
Porolithon onkodes	5	30	2	20
Algal Cover (%)	71		61	

Table 2. (continued)

Species	Transects 5 RA	5 F	6 RA	6 F
	REEF TERRACE			
CYANOPHYTA				
Microcoleus lyngbyaceus	6	32	12	41
Schizothrix calcicola	2	4	2	4
CHLOROPHYTA				
Caulerpa antoensis			2	9
Caulerpa racemosa			<1	4
Dictyosphaeria cavernosa	2	18	<1	4
Dictyosphaeria versluysii	1	9	2	4
Halimeda discoidea			1	9
Neomeris annulata			<1	4
Neomeris vanbosseae			1	4
PHAEOPHYTA				
Dictyota friabilis	5	36	5	23
Feldmannia indica			<1	4
Lobophora variegata	16	54	6	27
Padina japonesii	1	9	1	9
Sargassum tribuloides	6	18		
RHODOPHYTA				
Amphiroa fragilissima			<1	4
Chondria sp.	6	32		
Galaxaura marginata			2	14
Gelidium pusillum	6	18	11	23
Jania capillacea	6	36	2	9
Polysiphonia sp.	4	18	22	41
Porolithon onkodes	13	45		
Tolypiocladia glomerulata	26	50	26	45
"coralline"			4	4
Algal Cover (%)	83		72	

Table 3. Checklist of corals recorded from the Uruno Point study area.

Species	Inner Reef Flat	Outer Reef Flat	Reef Terrace
Acanthastrea echinata (Dana)			X
Acropora abrotenoides (Lamarck)			X
A. aspera (Dana)		X	
A. hebes (Dana)	X	X	
A. humilus (Dana)			X
A. tubicinaria (Dana)		X	
Astreopora listeri (Bernard)			X
A. myriopthalma (Lamarck)			X
Coscinarea columna (Dana)			X
Cyphastrea chalcidicum (Forskaal)			X
C. serailia (Forskaal)			X
Favia pallida (Dana)			X
F. stelligera (Dana)			X
Favites virens (Dana)		X	
Fungia fungites var. incisa Doederlein			X
Goniastrea pectinata (Lamarck)			X
G. retiformis (Lamarck)	X	X	X
Heliopora coerulea (Pallas)			X
Leptastrea purpurea (Dana)			X
Leptoria phrygea Ellis & Solander			X
L. sp.		X	
Millepora dichotoma Forskaal		X	
M. exaesa Forskaal			X
M. platyphylla Hemprich & Ehrenberg			X
Montipora conicula Wells			X
M. floweri Wells			X
M. tuberculosa (Lamarck)			X
M. verrucosa (Lamarck)			X
Oulophyllia crispa (Lamarck)			X
Pavona clavus (Dana)			X
P. varians (Verril)		X	
Platygyra rustica (Dana)			X
Pocillopora damicornis (Linnaeus)	X	X	
P. verrucosa (Ellis & Solander)			X
P. sp.			X
Porites lichen (Dana)			X
P. lutea Milne Edwards & Haime	X	X	X
Psammocora contigua (Esper)	X	X	
Stylophora mordax (Dana)			X

Table 4. Relative abundance (RA), frequency (F) and percent coverage for the reef flat corals quantified on the inner and outer reef flat based on four transects at the Uruno Point study area. See Fig. 2 for locations of Transects 1-4.

SPECIES	TRANSECTS 1 RA	1 F	2 RA	2 F	3 RA	3 F	4 RA	4 F
				INNER REEF FLAT				
Acropora hebes			40	10	100	20	50	10
Goniastrea retiformis	8	10	2	10				
Pocillopora damicornis			20	10				
Porites lutea	54	20					50	10
Psammorora contigua	38	10	20	10				
Per Cent Coverage (%)	18		12		13		13	
				OUTER REEF FLAT				
Acropora aspera					4	10		
A. hebes	79	70	52	50	78	70	28	20
A. tubicinaria							4	10
Favites virens							9	10
Goniastrea retiformis	13	20	40	40			18	10
Leptoria sp.	3	10						
Millepora dichotoma							14	10
Pavona varians					2	10		
Pocillopora damicornis			3	10	8	20	9	20
Porites lutea	3				8	10	14	10
Psammocora contigua	2	10	5	10			4	10
Per Cent Coverage (%)	24		26		26		14	

Table 5. Relative density (RD), frequency (F) and total density for the reef terrace corals quantified on the reef terrace based on two transects at the Uruno Point study area. See Fig. 2 for locations of Transects 5 and 6.

SPECIES	TRANSECTS 5 RD	5 F	6 RD	6 F
Acanthastrea echinata	03	10	03	10
Acropora abrotenoides	05	20	03	10
A. humilis	03	10		
Astreopora listeri	02	10	03	10
A. myriopthalma	02	10		
Coscinarea columna			02	10
Favia palida	12	40	02	10
Goniastrea retiformis	08	30		
Heliopora coerulea			02	10
Leptastrea purpurea			13	50
Millepora exaesa	05	10	05	20
Montipora conicula	20	40	37	90
M. tuberculosa	07	30	05	20
M. verrucosa	05	20	10	30
Oulophyllia crispa	02	10		
Platygyra rustica	08	30	05	10
Pocillopora sp.	10	30		
Porites lichen	08	30	10	40
TOTAL DENSITY	.15/m^2		.16/m^2	

Table 6. Checklist of fishes recorded from the Uruno Point study area. Symbols: + - species present; * - species made up more than 10% of total number of fishes observed on one or more of the surveys in the indicated environmental zone.

Species	Inner Reef Flat	Outer Reef Flat
ACANTHURIDAE		
Acanthurus olivaceous Bloch and Schneider		+
A. lineatus (Linnaeus)	+	+
A. nigrofuscus Forskaal	*	*
A. triostegus (Linnaeus)	+	+
Naso literatus Bloch and Schneider		
APOGONIDAE		
Cheilodipterus quinquelineata Cuvier and Valenciennes	+	
BALISTIDAE		
Rhinecanthus rectangularis (Bloch and Schneider)		+
BLENNIIDAE		
Cirripectus sp.	+	
BOTHIDAE		
unidentified bothid	+	
CANTHIGASTERIDAE		
Canthigaster solandri (Richardson)		+
CHAETODONTIDAE		
Chaetodon auriga Forskaal	+	+
C. citrinellus Cuvier	+	+
C. ephippium Cuvier		+
C. quadrimaculatus Gray		+
Megaprotodon strigangulus (Gmelin)		+

Table 6. (continued)

Species	Inner Reef Flat	Outer Reef Flat
CIRRHITIDAE		
Cirrhitus pinnulatus (Bloch and Schneider)	+	+
GOBIIDAE		
Eleotrides strigatus (Brovssonet)	+	
HOLOCENTRIDAE		
Adioryz sp.	+	
LABRIDAE		
Cirrhilabrus sp.	*	*
Gomphosus varius Lacepede		+
Halichoeres hortulanus (Lacepede)		+
H. marginatus Ruppell	+	+
H. trimaculatus (Quoy and Gaimard)	*	*
Hemigymnus fasciatus (Bloch)		+
H. melapterus (Bloch)		+
Labroides dimidiatus (Cuvier and Valenciennes)		+
Stethojulis axillaris (Quoy and Gaimard)	+	+
Thallasoma hardwickei (Bennett)	+	+
T. purpureum (Forskaal)		+
LUTJANIDAE		
Scolopsis cancellatus (Cuvier and Valenciennes)		+
MUGILOIDIDAE		
Parapercis cephalopunctatus (Seale)	+	
MULLIDAE		
Mulloidichthys auriflamma (Forskaal)		+
M. samoensis (Gunther)		+
Parupeneus pleurostigma (Bennett)		+

Table 6. (continued)

Species	Inner Reef Flat	Outer Reef Flat
POMACENTRIDAE		
Abudefduf amabilis (De vis)	*	*
A. dicki (Lienard)		+
A. glaucus (Cuvier and Valenciennes)	*	*
A. leucopomus (Lesson)	*	*
A. leucozona (Bleeker)		+
A. septemfasciatus (Cuvier and Valenciennes)	+	+
A. sordidus (Forskaal)	+	*
Chromis caeruleus (Cuvier and Valenciennes)	*	*
Dascyllus aruanus (Linnaeus)	+	*
Pomacentrus amboinensis Bleeker	+	
P. nigricans (Lacepede)	+	+
P. vaiuli (Jordan and Seale)	+	
SCARIDAE		
Xanothon margaritus (Cartier)		+
juvenile scarids		+
unidentified scarid	+	
TETRAODONTIDAE		
Arothron hispidus (Lacepede)		+
Number of species	28	41

Total number of species observed=50

Table 7. Checklist of the conspicuous macroinvertebrates in the Uruno Point study area.

PORIFERA
- Cirachyra australiensis (Carter)

MOLLUSCA
- Bivalvia
  - Tridacna maxima (Roding)
- Gastropoda
  - Conus chaldaeus Roding
  - C. ebraeus Linnaeus
  - C. miles Linnaeus
  - C. miliaris Hwass
  - C. sponsalis Hwass
  - Cymatium pileare Linnaeus
  - Cypraea moneta Linnaeus
  - C. tigris Linnaeus
  - Drupa ricinus (Linnaeus)
  - Lambis sp.
  - Latirus sp.
  - Thais tuberosa Roding
  - Nerita plicata Linnaeus
  - Trochus niloticus Linnaeus
  - Turbo argyrostoma Linnaeus
  - Vasum ceramicum (Linnaeus)
  - V. turbinellus (Linnaeus)

ECHINODERMATA
- Asteroidea
  - Choriaster granulatus Lutken
  - Culcita novaeguineae Muller & Troschel
  - Linckia laevigata (Linnaeus)
  - Linckia pacifica Gray
- Echinoidea
  - Echinometra mathaei (de Blainville)
  - Echinostrephus sp.
  - Echinothrix diadema (Linnaeus)
- Holothuroidea
  - Actinopyga echinitus (Jaeger)
  - Bohadschia argus (Jaeger)
  - B. bivittata (Mitsukuri)
  - Holothuria (Halodeima) atra Jaeger
  - H. (Semperathuria) cinerascens (Brandt)
  - H. (Platyperona) difficilis Semper
  - H. (Thymiosycia) hilla Lesson
  - H. (Microthele) nobilis (Selenka)
  - Stichopus chloronatus Brandt

CRUSTACEA
- Diogenidae (hermit crabs)
  - Calcinus gaimardi (H. Milne Edwards)
  - Dardanus guttatus (Olivier)

APPENDIX G

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region • Western Pacific Program Office
2570 Dole St. • Honolulu, Hawaii 96822-2396

December 30, 1986 F/SWR1:LDC

Helene Takemoto
Environmental Planning Division
U.S. Army Corps of Engineers
Building 230
Fort Shafter, Hawaii 96858

Dear Ms. Takemoto:

In response to your December 29, 1986 request for information on sea turtles on Guam, I enclose portions of Peter Pritchard's 1981 paper entitled, "Marine Turtles of Micronesia." Both green turtles (Chelonia mydas) and hawksbill turtles (Eretmochelys imbricata) are noted as nesting in the vicinity of the proposed dump site clean-up area, between Uruno Point and Achae Point, though the northeast side of the island (Ritidian Point to Pati Point) produced the majority of aerial turtle sightings.

Please let me know if I can be of further help.

Sincerely yours,

Lewis D. Consiglieri
Protected Species Program

Enclosure

Biology and Conservation of Sea Turtles

KAREN A. BJORNDAL,
Editor

Proceedings of the

World Conference

on

Sea Turtle Conservation

Washington, D.C.

26–30 November 1979

Smithsonian Institution Press

Washington, D.C.

In cooperation with

World Wildlife Fund, Inc.

Washington, D.C.

1981

Peter C. H. Pritchard
Florida Audubon Society
1101 Audubon Way
Maitland, Florida 32751

Marine Turtles of Micronesia

The islands of Micronesia comprise 1 of the 3 great groups of Pacific Oceanic Islands. They are almost all located north of the Equator, being situated east of the Philippines and southwest of the Hawaiian Islands. The boundaries of Micronesia are almost identical to those of the U.S. Trust Territory, with the exception that Guam, an unincorporated territory of the United States, is not part of the Trust Territory, while the Gilbert Islands (part of the independent Kiribati), and the independent Nauru are considered part of Micronesia. Nukuoro and Kapingamarangi Atoll, though included in the Trust Territory, are culturally considered to be part of Polynesia. Moreover, the northern Marianas Islands have recently achieved Commonwealth status with the United States. The islands are all small and distances between them are large. Micronesia occupies an area equal to that of the United States, yet the land area is only half that of Rhode Island. Bryan (1971) calculates the total number of islands in Micronesia as 2,203. The 1973 population was 114,973 (excluding Guam), with an annual growth rate of 3.6 percent. The total land area is only 1,851 km^2.

Geologically the islands are all of volcanic origin, but differing age and subsequent weathering, subsidence, and coral formation have given them a very varied physiognomy. As a first-order approximation, the eastern islands are typically low atolls, often composed of many dozens of small, narrow islands surrounding a large central lagoon. The westernmost islands contain much weathered limestone and reach much higher altitudes. The highest islands, such as Ponape, attract an exceedingly high rainfall, with consequently lush vegetation. Shoreline vegetation throughout the Territory shows certain dominant species, such as coconut palms (*Cocos*), *Pandanus*, *Messerschmidtia*, *Portulaca*, *Sida*, and *Scaevola*.

Species Present

The hawksbill (*Eretmochelys imbricata*) and the green turtle (*Chelonia mydas*) are present throughout Micro-

Table 1. Summary of turtle sightings by aerial survey region, Guam, Fiscal Years 1975 through 1979

	Region												Total sightings	Number of months
	1	2	3	4	5	6	7	8	9	10	11	12		
FY 1979	4	1	1	1		1	6	2	43	31	18	77	185	12
FY 1978	6	3	1	9		6	14	3	10	1	15	15	83	12
FY 1977	0	3	1	1		4	1	5	10	0	8	8	41	2
FY 1976	7	5	6	6		35	8	14	44	10	12	42	189	9
FY 1975	14	5	18	3		23	11	9	37	16	6	143	285	6
Total	31	17	27	20		69	40	33	144	58	59	285	783	41
$\bar{x}$/Region	6	4	6	4		15	8	8	31	12	13	59	—	—

Source: Molina, unpublished report.

one of the most valuable sources available on human attitudes to turtles in Micronesia. To avoid duplication, reference is made to McCoy's paper herein for information on turtles in the Yap District.

Marianas District and Guam

Hendrickson (in manuscript) quoted the following information, received from Isaac I. Ikehara, chief of the Guam Division of Fish and Wildlife, regarding the available information on sea turtles in Guam in 1968:

Green turtles and hawksbills are reported to occur in Guam waters. They apparently nest on the island beaches, but only sporadically; eggs were harvested more commonly during the time before the second World War, in many areas of the island, especially on the northern and southern ends (Tarague, Ritidian, Uruno, Orote, Cocos Island, Asiga Beach, and other localities).

It appears from local residents that sea turtles are a rarity on the local market and the consultant found none on three of his visits. Skin divers occasionally bring them back but they are not considered a normal commercial item although red turtle meat is reputed to sell at $0.75 (US) per pound. There is no export of turtle products from Guam. In 1968 there were reportedly two divers specializing in turtles each catching three or four turtles on a good day.

There is apparently no legislation protecting sea turtles or regulating the catch in any way, but there are some good catch statistics. All sizes from 15 lb. to 400 lb. are taken, but the informant estimates that the average size is around 60 lb. (the type most likely to be taken by divers). No special feeding grounds have been identified.

Harry Kami, enforcement officer for the Guam Fish and Wildlife Division, made a number of flights over the Guam coast during the last couple of years, and saw sea turtles—sometimes in concentrations of 40 or 50 individuals—off the northern coast of Guam, between Ritidian Point and Pati Point. Kami also sometimes saw 3 or 4 turtles off the coast near Inarajan Bay, on the southeast coast, and said that turtles formerly nested on Cocos Island, off the southwest coast, although the island was now too intensively visited for nesting to take place.

The north coast of Guam, near which the turtles were seen, was under Air Force control, and was rather little visited. However, despite the presence of a good beach, little nesting took place here. Factors that lessen the suitability of this beach for nesting may include the shallow reef (only 1 m submergence by high tide), and the presence of dense vegetation above the high tide line on the beach. Most of the turtles seen off Guam were of adult size, and indeed appeared to be very

Table 2. Summary of turtle sightings by month, Guam, Fiscal Years 1975 through 1979

	Month												Total sightings	Number of flights
	J	A	S	O	N	D	J	F	M	A	M	J		
FY 1979	12	3	6	6	7	12	18	52	24	14	20	11	185	24
FY 1978	7	6	10	4	16	17	7	5	0	3	4	4	83	24
FY 1977	23	—	—	18	—	—	—	—	—	—	—	—	41	4
FY 1976	—	20	28	24	20	42	16	10	7	22	—	—	189	18
	—	—	—	—	—	—	45	44	32	46	54	64	285	12
Total	42	29	44	52	43	71	86	111	63	85	78	79	783	82
$\bar{x}$/Month	14	12	15	13	14	24	22	28	16	21	26	26	—	—

Source: Molina, unpublished report.

large from an aircraft at 65 to 80-m altitude; but mating pairs had not been seen.

Kami found 1 green turtle nest on the east coast of Guam between Ylig Bay and Togcha in 1974. Because of the extensive human use of this beach, the eggs were moved and, while reburying them, several incomplete nests were found.

Dr. Lucius Eldredge informed me by letter (dated 12 July 1976) that Dick Randall of the University of Guam Marine Laboratory reported 6 recent turtle nests on June 26, 1976, at the north edge of Sella Bay on the southwest coast of Guam.

A recent unpublished report by Molina includes the results of 5 years of aerial surveys of turtles around Guam. The following section is extracted from this report:

The island of Guam was divided into 12 survey regions (Figure 1). Marine turtles have been sighted within every survey region (Table 1) and during all months of the year (Table 2). Region 5 has not been censused due to military restriction. Two flights were made each month in all cases. A total of 783 marine turtles have been sighted around Guam on 41 aerial surveys made during the past 5 years. Far more turtles were sighted within region 12 (Pati Pt.-Ritidian Pt.) than in any other (Table 1). Approximately 74 percent of the observed turtles were seen within regions 8 to 12. The most probable explanations for this distribution are the low levels of development and fishing pressure in these areas.

Marine turtle abundance appears to peak twice during the year (Table 2). In general, these peaks coincide with the winter (December to February) and late spring (May to June) months. This also loosely correlates with Guam's "dry," tradewind season which usually lasts from December to June. It is unclear at the present time whether or not the turtles are mating during the entire period, yet it seems likely. The time of nesting is also unclear. However, reports from local fishermen indicate that nesting occurs around June.

Reports have been made of larger than usual numbers of turtles visiting Guam about every 3 years. The last of these visits happened in 1976, and is reflected in our aerial survey data (Table 2). Another visit was expected this year. Again, our data show the winter increase in numbers.

Since it is difficult to make positive species identifications on turtles from a moving airplane, we have no reliable estimate of the species composition of Guam's marine turtle community. However, it is generally regarded that Chelonia mydas *is by far the major component.*

Human interference with nesting turtles is a serious problem at Taragüe Beach. The majority of the problem lies with the friends and relatives of the Taragüe landowners who use the beach for "4-wheeling" and who actively hunt for turtle eggs. Since Taragüe Beach is privately owned and enjoys military isolation, there may be a good chance

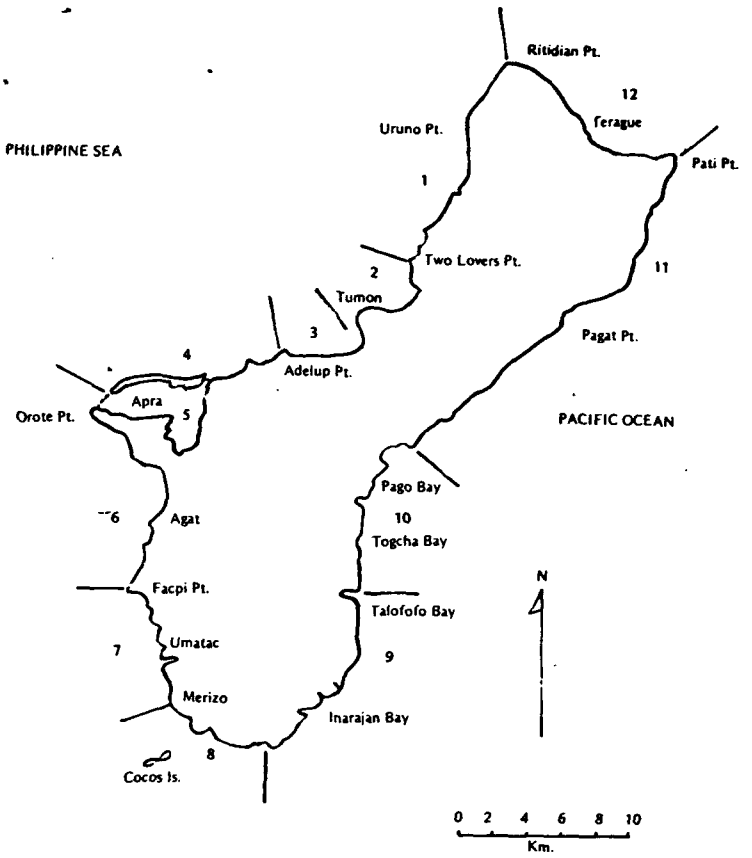

Figure 1. The island of Guam with its 12 aerial survey regions.

of controlling this problem, especially if the area could be designated as a marine turtle sanctuary. If it is not already too late, Taragüe Beach may be Guam's only hope for such a valuable natural resource. Mr. Castro appears to be pro-turtle conservation and has offered to do what he can in cooperation with our office to help protect these animals.

Turtle meat is occasionally sold in Guam, but is very expensive—although it can on occasion be purchased with U.S. government food stamps at Perez Market. There are no laws protecting turtles in Guam at the present time, and some opposition to establishing local laws because turtles protected in Guam may well be caught in the Trust Territory. However, because Guam is an unincorporated territory of the United States, federal law unquestionably applies, and hawksbills should already have legal protection. The green turtle too should soon receive nominal protection.

Very few Guamanians are expert at spearing sea turtles, with the exception of a few old-timers, and nets are never used nowadays for catching turtles.

North of Guam, the Northern Marianas Islands stretch in a slightly curved elongated chain. Few turtles appear to nest anywhere in the Marianas; to a large extent this may reflect shortage of nesting beach, most of the uninhabited islands having no beach whatsoever. Saipan has several kilometers of beach on the west coast, but

APPENDIX H

ARCHAEOLOGICAL RECONNAISSANCE SURVEY FOR THE PROPOSED CLEAN-UP OF MILITARY DEBRIS AT URUNO POINT, TERRITORY OF GUAM

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U.S. Army Engineer Division,
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October 1986

ARCHAEOLOGICAL RECONNAISSANCE SURVEY FOR THE PROPOSED CLEAN-UP OF MILITARY DEBRIS AT URUNO POINT, TERRITORY OF GUAM

I. Introduction.

Archaeological investigations were performed at the site for proposed removal of military debris at Uruno Point, northwestern Guam, from July 16-18, 1986. The property, owned by the Artero family and adjacent to Andersen Air Force Base, includes two (2) prehistoric archaeological sites listed on the National Register of Historic Places- sites 66-08-0010 and 66-08-0011. Field investigations were performed by C.F. Streck, Jr., Archaeologist, U.S. Army Corps of Engineers, Pacific Ocean Division, and John Salas, Fabiola Calkins, and Lynda Aguon from the Guam Territorial Archaeology Laboratory. A non-intensive, walk-through archaeological reconnaissance survey was performed in order to verify the continuing presence of the archaeological sites and to assess any impacts which may have effected them subsequent to their nomination to the National Register of Historic Places in 1974. Archaeological survey was performed along the upper surface of the limestone cliff adjacent to Andersen Air Force Base in the vicinity of the former military debris dumps, along the lower elevation ledges of the cliff, and along the entire Uruno Beach.

II. Environment.

Guam, the largest island in Micronesia, has an area of 209 sq. miles measuring 30 miles long by 4-8 miles wide. It is situated in the far western Pacific Ocean at latitude 13 degrees north. The island is geologically and physiographically divided into two sharply differentiated provinces- a northern raised limestone plateau sloping from 200-600 feet elevation from south to north and a southern volcanic, highly dissected landscape ranging from sea level to 1,334 feet elevation.

Present vegetative cover in the northern limestone plateau consists largely of dense stands of tangan-tangan (Leucaena glauca), a leguminous shrub sown throughout the Mariana Islands by the military after World War II. Former vegetation, present still along some steep slopes and isolated beach areas, consisted of banyan (Ficus prolixa), wild breadfruit (Artocarpus mariannensis), and Mammea odorata for the upper story, and Ochrosia, Eleocarpus, Morinda citrifolia, Cycas circinalis, and other small trees, lianas, and epiphytes for the understory.

2500 or earlier B.C. to about A.D. 500-800 whereupon the latte cultures persisted into the early periods of Western (Spanish) contact on the island (A.D. 1600's).

Based on current archaeological research data, the first inhabitants of Guam were probably settlers from the Philippines-Eastern Indonesian area of Southeast Asia (e.g. Bellwood 1979). Although most research on Guam has been associated with the Latte era cultural remains, the Pre-Latte cultures apparently flourished after initial settlement. Remains from this era, including a well-developed pottery industry, burial grounds, and settlements tend to be concentrated along the shoreline and in major stream valleys. During both the Pre-Latte and Latte, settlement was dispersed over the island, probably organized into small local kinship-based chieftomships (Cordy 1983; Cordy and Allen 1986). Alliances between chiefdoms may have formed so as to allow exchange of resources between coastal and inland areas as well as for warfare. The incidence of warfare appears to have escalated during rapid population increase and expansion into interior portions of Guam during the Latte era, e.g. competition for scarce resources.

The economic system was apparently based on the use of sophisticated fishing and marine resources harvesting and hunting technology, horticultural gardening of a variety of tropical cultigens (including possible rice cultivation), exploitation of wild plant resources (mostly Cycad species), and to a much lesser degree, hunting of native birds and fruit bat. Population size during the Latte era was probably quite large, perhaps equalling the present population of Guam. During most of prehistory intensive contact was maintained between Guam and the other Mariana Islands, and sporadic, but likely continuous contact was probably maintained between Guam and the central and southern Philippine Islands.

IV. Previous Archaeological Research.

Very little archaeological research has been performed in the northern limestone plateau and bordering beach areas of the island of Guam. Most research has tended to be concentrated in the southern and central volcanic and geological transitional areas of the island where recent economic and military development has been concentrated (i.e. Cordy and Allen 1986; Graves and Moore 1985; McCoy, Price, and Craib 1978; Reinman 1977; Shutler 1978; etc.). In the northern portion of Guam most archaeological attention has been directed towards investigating the early cultural remains present at Tarague Beach on the north coast (Athens 1986; Kuroshima and Clayshulte 1983a, 1983b; Kuroshima, et al, 1981; Moore 1983; Ray 1980; Reinman 1977). These cultural remains are of high research significance,

The northern Guam shoreline is typically bordered by narrow sand beaches at the base of steep limestone cliffs. Because of the limestone substrate there are no perennial stream and river courses as in the southern half of the island despite high annual rainfall. Numerous seeps and wet caves are present in the limestone however. The coral reef in the northern portion of Guam is quite restricted in size. This fringing reef is often transgressed by high storm waves and contains only narrow, infrequent passes to the open ocean in contrast to the wide reefs and lagoons along the southern shoreline.

There are, therefore, major environmental differences between the northern and southern halves of Guam including distinctive characteristics of geology, physiography, vegetation, soils, and freshwater availability which would have had an effect on prehistoric cultural adaptations in the areas.

The present project area is very typical of the northern Guam shoreline. It consists of the top, slopes, and base of a steep limestone cliff varying from 450-500 feet in elevation. A long, narrow sandy beach is situated between the base of this cliff and the ocean. All of the area is heavily vegetated with only small areas of economic plants on the beach and the upper cliff surface. The only direct access to the slopes and beach is by a steep, torturous footpath while the upper areas can be reached by paved highway through Andersen Air Force Base. Although the upper limestone plateau portions of the project area have been extensively graded and altered in recent years, the remainder shows very little evidence for modern disturbance.

III. Guam Prehistory.

The prehistory of Guam, and the Mariana Islands of which it is the southernmost portion, is generally viewed as consisting of two major periods: the earlier pre-latte and later latte. The term latte refers to large stone uprights (halege) and capstones (tasa) on which houses were constructed. These represent the most visible prehistoric architextural artifact in the Mariana Islands. There is considerable variation in size and height of these structures ranging from megalithic to quite modest in size.

The Pre-Latte sites have not been associated, thus far, with distinctive structural remains but have rather been primarily defined on the basis of pottery typology (e.g. Spoehr 1957). Prehistoric potsherds from the Pre-Latte and Latte "periods" are usually the most abundant and ubiquitous portable artifacts found at Guamanian archaeological sites, particularly those situated along or near the shoreline. The Pre-Latte period in the Mariana Islands has been posited to have existed from perhaps as early as

within the former military dump sites. Following island-wide depopulation during and after the Spanish-Chamorro Wars (A.D. 1600's) the northern portion of Guam was largely abandoned and only minimally used. The only known site in the Uruno area from the Spanish colonial period was the former hacienda of Casa Real, near Ritidian Point.

V. Survey Methods and Results.

Archaeological survey was performed in order to determine the likelihood of adverse impact to significant historic properties as pursuant to Sections 106 and 110 of the National Historic Preservation Act of 1966 (as amended) through the proposed removal of debris from three former military dumps situated along the steep slopes above Uruno and Falcons beaches, northwestern Guam (Figure 1). All of the dumpsites are situated on private land along very steep, inaccessible slopes adjacent to Andersen Air Force Base. The dumps were apparently used for the disposal of worn airplane and machine parts, various equipment, metal drums, miscellaneous metal debris, and possibly spent ordnance including some from the massive cleanup efforts on Guam following World War II. The dumps have probably not been in use since some time in the late 1960's- early 1970's. In addition to these former dumpsites one other area was investigated archaeologically. This consisted of a former borrow pit situated east of the paved road on the limestone plateau above Uruno Point. This is the proposed disposal site for the debris to be removed from the former dumpsites. The area had been extensively quarried and bulldozed; no historic properties were identified.

Archaeological method included pedestrian reconnaissance (walk-through) survey by the author either alone (one day) or accompanied by experienced staff members of the Guam Territorial Archaeology Laboratory (two days). Copies of the National Register of Historic Places and the Guam Register of Historic Places inventory-nomination forms were graciously supplied by the Guam Historic Preservation Office in order to aid in the identification and interpretation of historic properties in the vicinity of the dumpsites. Field notes and a photographic record were compiled of all portions of the survey. No plan view site maps, site locating through use of a surveyors transit nor artifact collection was done at this time. The broad aims of the survey were to briefly determine the presence of previously identified archaeological sites in the vicinity and to assess their probable location to the dumpsites. This data shall be used in order to ensure that sufficient "formal" archaeological investigations are performed early in the planning for removal of debris from the dumpsites.

containing data indicative of several thousands of years of human habitation and use of the area. Possibly one of the earliest radiocarbon dates yet derived for a Mariana Islands and/or Micronesian archaeological site has been obtained from excavations at Tarague Beach (ca. 1905-780 B.C.) although the positive cultural provenience of the dating sample is somewhat questionable (Athens 1986).

Archaeological investigations in other areas of northern Guam and Uruno Beach have been extremely limited in scope and non-intensive. Hornbostel (1921-23) performed perhaps the most intensive research in the area during the 1920's, concentrating on cultural remains at Uruno and Falcons beaches. A number of prehistoric latte house sites and other remains, including stone-lined wells and mortar stones, were identified and described during his investigation.

Excavations by Hornbostel at Uruno Beach identified two human burials associated with the latte house sites. At least 5 large latte sets were described and were assessed to have been the most uniform in size and shape and "finer" than any others yet found on Guam. The excavations also suggested that a deep, stratified cultural deposit may be present over extensive areas of the inner beach and cliff base. The deposits contained dense charcoal, pottery sherds, and artifacts including large mortar stones, a "stone weapon" (the only such artifact ever found on Guam), stone "implements," and shell scrapers in addition to the human burial remains. The Uruno latte sites were considered to be highly distinctive from others found on Guam because of their uniform and highly stylized construction. These were assessed to be "the culmination of coral head tasa (capstone) development on Guam." In addition to the latte sites, rock-lined wells and limestone quarrys were also identified. One of the latte uprights and capstone was removed at this time and shipped to Honolulu. It is now on display on the grounds of the B.P. Bishop Museum.

The only other archaeological investigation to be performed at Uruno was in the early 1970's (Reinman 1974a, 1974b) during island-wide site inventory survey for National Register of Historic Places nominations (see Enclosures 1 and 2). Two sites were identified at that time consisting of the Uruno Complex (66-08-0010) and the Uruno Beach Complex (66-08-0011). At least seven (7) standing latte sets, dense cultural deposits, several rockshelters, caves, and some usage of flat areas on higher contours above the beach were identified at this time but only minimally described. No detailed site placement nor excavations were performed at that time.

No historic era (A.D. 1600's to 1800's) structures or artifacts have been identified at Uruno aside from those associated with present land use of the property and the remains

All of the limestone plateau between the paved access road to the property through Andersen Air Force Base to the edge of the cliff was inspected through two long transects extending from upslope of dumpsite #1 to dumpsite #3. Vegetation within this area is extremely dense seriously impeding ground visibility. Portions of the area near dumpsite #2 contain the Artero family (the property owners) ranch house. Most of this area appears to have been graded. Relict bulldozer-grader furrows are visible. The upper portions of the steep slopes and dumpsites #2 and #3 are visible from the cliff edge but the steepness of the slope generally precluded extensive ground inspection. No archaeological sites or cultural remains were identified in this area. The steepness of the upper cliff slopes would also make it highly unlikely that any in situ cultural remains are present.

A narrow, switchback foot trail extends from the upper plateau near the Artero ranch to the lower slopes and beach at Uruno affording the only access to these areas on foot. The cluster of latte sites previously described for sites 66-08-0010 and 66-08-0011 are on the narrow sandy coastal plain only a short distance from the terminus of this footpath (Photographs 1-4). All of the latte sites described by Hornbostel (1921-23) and Reinman (1974a, 1974b) appear to be present and, although under dense vegetative cover, in excellent preservation. At least one (Photograph 4) and possibly more latte sets are present than what had been previously described.

The archaeological sites in this area, including the stone-lined wells (Photograph 5) and several large tabular boulder mortar stones, appear to be very extensive throughout the entire beach area. A large wet cave in the base of the limestone cliff and several small overhang rockshelters also probably contain cultural remains. At least three areas containing small overhangs which may have been used for cooking ovens and/or fireplaces were also identified in the cliff base. All of these had darkened "smudge" marks probably emanating from the fires at those locations. Surface indications of the presence of in situ cultural deposits were thickest near and close to the cliff base, gradually becoming less dense towards the current beach crest.

Surface cultural material is most dense immediately downslope from dumpsites #1 and #2. These consist of dense scatters of potsherds, marine shell and fish midden, charcoal chunks and blackened sands, amorphous linear alignments of limestone cobbles and coral chunks, at least two rectangular structural alignments, raised earthen areas containing particularly dense cultural material (possible cookhouse areas), and other cultural remains. All of this area appears to have been only minimally disturbed in recent times. The size of the potsherds on the surface is one indicator of the excellent state of preservation of this site. They are much larger than any previously encountered at prehistoric Guamanian archaeological

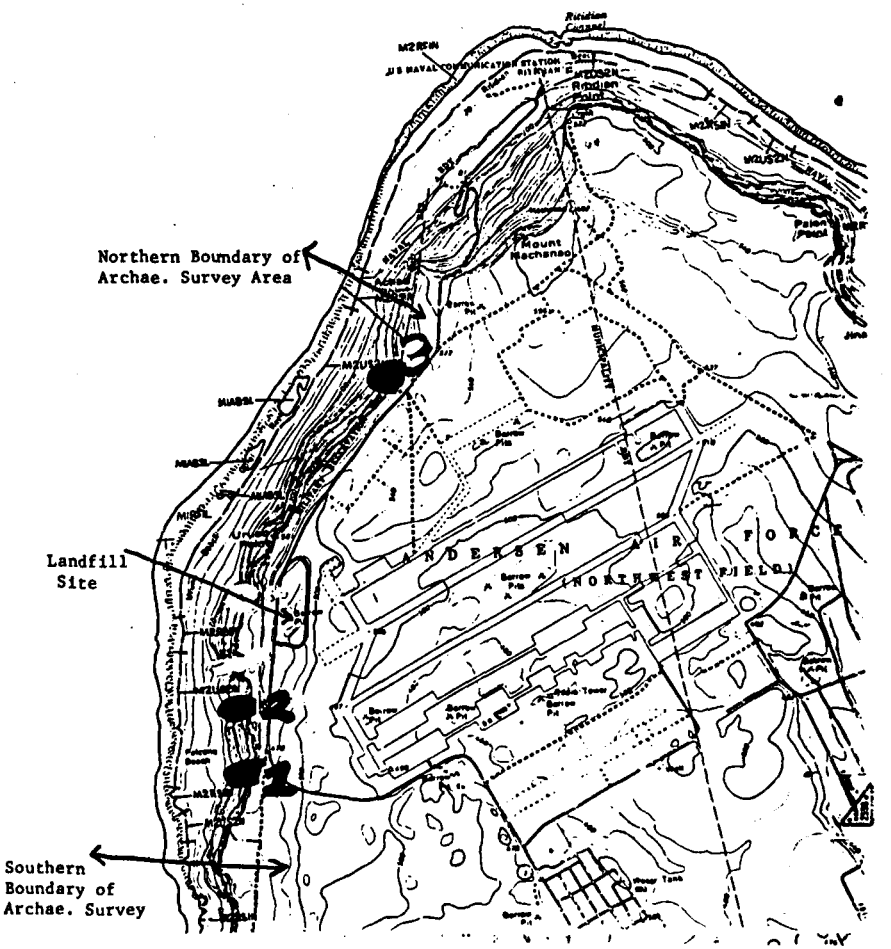

Figure 1. Location of former military dumpsites and archaeological reconnaissance survey areas at Uruno, northwestern Guam.

archaeological sites remain on Guam in such a high state of preservation. The limited access to the property and relative geographic isolation has preserved these remains from many modern disruptive activities. The research potential and historic preservation significance of the area cannot be minimized.

VI. Historic Preservation Recommendations.

Because of the extensiveness and potential importance of the cultural remains present at Uruno, a formal intensive archaeological survey of the lower limestone cliff slopes and the entire beach area fronting the three former military dumpsites is recommended prior to the final selection and planning for any debris-removal alternative which has the possibility of adversely affecting these areas. This intensive survey should include 100% ground survey; site plan-view mapping; surface artifact collection and sampling; accurate site and feature location; comprehensive site recordation; test excavation; and detailed data analysis and interpretation.

The results of such a intensive survey investigation can then be used for planning purposes in order to ensure that there is only minimal, if any, adverse effect to the historic properties in the area. The scope of such intensive survey would depend on the final debris-removal alternative selected. The potential for both direct and/or indirect adverse effect to these National Register of Historic Places sites is otherwise very great, especially for the proposed "bulldozer" alternative. The results of the intensive archaeological survey can also be used in order to enter into a Memorandum of Agreement between the U.S. Army Corps of Engineers, the U.S. Air Force, the Guam State Historic Preservation Office, and the President's Advisory Council on Historic Preservation ensuring that no unmitigated adverse effect to historic preservation properties occurs during the proposed debris-removal project. Depending upon the results of intensive archaeological investigations at Uruno, it may be possible to design a alternative that would not adversely effect significant archaeological areas.

sites. Several sherds were identified which composed ca. 20-40% of the original pot, greatly enhancing the research possibilities of these remains.

The beach area at Uruno-Falcona gradually constricts to the south terminating at a limestone headland containing a large sea cave. The beach becomes less rapidly constricted to the north of the access path towards Achae Point. This area is mostly contained within the site 66-08-0011 boundaries. Latte architectural features are less prevalent in this area although the density of surface midden, artifacts, and mortar stones is much greater than in the southern beach area. This may have represented the domestic activity support area for the residences (latte) situated in the southern half of the coastal strand. The density of cultural remains is dense immediately downslope from dumpsite #3.

The lower slopes of the limestone cliff in this area consist of a series of stepped terraces probably indicative of former shorelines (coastal benches). Various metal debris, particularly from dumpsites #1 and #2, have eroded onto these lower surfaces to the bench immediately above the coastal strand beach. Included among this metallic debris are probably armed World War II vintage Japanese ordnance (Photograph 7) and more recent American ordnance (Photograph 8). The Artero family reports that occasional explosions during the dry season are often heard coming from this area.

The lower slope terraces appear to have also been intensively utilized during prehistory or the early historic era. The natural ground surface consists of a highly pitted and jagged limestone containing dense scatters of loose pebbles and cobbles. This is formed through rainwater solution of the limestone substrate. Large areas of the terraces appear however to have been cleared of the rubble allowing for accumulation of slope-wash transported sediments. A great number of roughly conical clearing mounds of varying heights and massiveness are present along these terraces. These are roughly similar to mounds present in prehistoric agricultural fields throughout the Pacific. Some of the mounds, however, exhibit a degree of structural modification into rectangular, flat-topped platforms. Charcoal-indurated humic sediments, some marine mollusc shell, and fish bone was identified eroding from several of these platforms suggesting that they may have been used for residences (Photograph 6).

In sum, the variety and density of the cultural remains identified along the lower slope terraces and along the coastal beach strand at Uruno was much greater than expected or implied through the previous archaeological investigations in the area. It is highly doubtful if very many prehistoric coastal

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Kuroshina, H., D. Moore, O. Kataoka, R.N. Clayshulte, and E. Ray
1981 Prehistoric and protohistoric cultural occurences at Tarague, Guam. Asian Perspectives 24(1):57-68.

McCoy, Patrick C., Samuel T. Price, and John Craib
1978 Archaeological review of Orote historical complex, Orote Point, Guam. Report prepared for U.S. Navy, Pacific Division, Honolulu. B.P. Bishop Museum, Honolulu, and Pacific Studies Institute, Agana, Guam.

7. DESCRIPTION

CONDITION (Check One): ☐ Excellent ☒ Good ☐ Fair ☐ Deteriorated ☐ Ruins ☐ Unexposed

(Check One): ☐ Altered ☒ Unaltered — (Check One): ☐ Moved ☒ Original Site

DESCRIBE THE PRESENT AND ORIGINAL (If known) PHYSICAL APPEARANCE

The Uruno site is located on the NW coast of Guam .7 mile SW of Uruno Point (BH 581) and .3 mile N of Falcona Beach on USGS Ritidian Point Quadrangle Map (1968). It is on the property of Jose C. Artero of Agana, Guam. The site is reached by driving N on Highway 3, 3.2 miles from Potts Junction to a paved but badly deteriorated road .5 mile S of Uruno Point which leads W to the Cliffs. A steep trail leads from this area down the cliffs to the beach and enters the central part of the site at Mr. Artero's ranch.

The site is ca. 500-550 m long and 100 m wide running N/S along the 10 to 40 foot contours. Most of the structures, wells and midden remains occur on the lower elevations of the site although scattered pottery occurs on the limestone shelf above the main site area. At least 6 structures formerly occurred here, 4 of which are potentially restorable. Two large stone faced wells also occur, one each and in the northern and southern halves of the site. Rock shelters, a cave, and numerous midden areas as well as pottery and broken stone and shell tools occur throughout the site area.

The soil of the site is generally a brown to black sand containing limestone pebbles and other beach debris as well as artifacts, although the eastern upper contours of the site are primarily broken limestone and clay.

Vegetation is primarily Cocos sp., but Triphasia sp., Premna sp., Carica sp., Bambusa sp., Colocasia sp., and Alocasia sp., as well as various vines and ferns occur.

The latte uprights and caps are the stone house posts upon which the houses of the earlier inhabitants of the Marianas Islands were built. Generally, trapezoidal in outline, the pillars are capped by a semi-hemispherical capstone, on which the floor beams of the houses were placed. The uprights are arranged in relatively evenly spaced pairs which form two parallel rows of from 4 to 14 stones; 8 and 10 stone structures are the most common on any given site. It is also thought that only the most important structures in a settlement were built on these latte foundations; other dwellings being built on wooden house posts or on the ground. The stone mortars which are found in association with the latte structures, were used during historic and probably prehistoric times for the processing of rice. Other foods requiring grinding during processing include the cycad (Cycas circinalis). These nuts were an important source of food during earlier times and may have been processed in the mortars as well.

History begins on Guam after 1521 A.D. with most historic villages being developed after the first permanent settlement in 1668. Archaeologically, these historic villages may be distinguished by the presence of non-native artifacts and manufacturing techniques including metal and wheel-made and kiln-fired pottery.

SEE INSTRUCTIONS

Form 10-300 (Rev. 6-72)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES INVENTORY – NOMINATION FORM

(Type all entries – complete applicable sections)

STATE: Guam
COUNTY: N/A
FOR NPS USE ONLY
ENTRY DATE:

1. NAME
COMMON: Uruno
AND/OR HISTORIC: Falcona, Fasonan, Oruno

2. LOCATION
STREET AND NUMBER: 0.7 Miles Southwest of Uruno Point
CITY OR TOWN: Dededo
CONGRESSIONAL DISTRICT: Guam
STATE: Guam — CODE: 66 — COUNTY: N/A — CODE: 300

3. CLASSIFICATION

CATEGORY (Check One)	OWNERSHIP		STATUS	ACCESSIBLE TO THE PUBLIC
☐ District ☐ Building	☐ Public	Public Acquisition:	☒ Occupied	Yes:
☒ Site ☐ Structure	☒ Private	☐ In Process	☐ Unoccupied	☒ Restricted
☐ Object	☐ Both	☐ Being Considered	☐ Preservation work in progress	☐ Unrestricted
				☐ No

PRESENT USE (Check One or More as Appropriate)

☐ Agricultural	☐ Government	☐ Park	☐ Transportation	☐ Comments
☐ Commercial	☐ Industrial	☐ Private Residence	☒ Other (Specify) RANCH	
☐ Educational	☐ Military	☐ Religious		
☐ Entertainment	☐ Museum	☐ Scientific		

4. OWNER OF PROPERTY
OWNER'S NAME: Jose C. Artero, Consuelo A. Calvo, and Antonio C. Artero
STREET AND NUMBER: Post Office Box 752
CITY OR TOWN: Agana — STATE: Guam — CODE: 66

5. LOCATION OF LEGAL DESCRIPTION
COURTHOUSE, REGISTRY OF DEEDS, ETC.: Department of Land Management
STREET AND NUMBER: Administration Building
CITY OR TOWN: Agana — STATE: Guam 96910 — CODE: 66

6. REPRESENTATION IN EXISTING SURVEYS
TITLE OF SURVEY: Notes on an Archaeological Survey of Guam, Marianas Islands
DATE OF SURVEY: 1965-66 ☐ Federal ☒ State ☐ County ☐ Local
DEPOSITORY FOR SURVEY RECORDS: Department of Commerce
STREET AND NUMBER: Post Office Box 682
CITY OR TOWN: Agana — STATE: Guam 96910 — CODE: 66

STATE: Guam
COUNTY: N/A
FOR NPS USE ONLY
ENTRY NUMBER
DATE

SEE INSTRUCTIONS

ENCLOSURE 1

NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES
PROPERTY PHOTOGRAPH FORM

(Type all entries - attach to or enclose with photograph)

SEE INSTRUCTIONS

COUNTY: N/A

FOR NPS USE ONLY

ENTRY NUMBER | DATE

1. NAME

COMMON: URUNO

AND/OR HISTORIC: FALCONA, FASONAN, ORUNO

2. LOCATION

STREET AND NUMBER: 0.7 MILES SOUTHWEST OF URUNO POINT

CITY OR TOWN: DEDEDO

STATE: GUAM | CODE: 66 | COUNTY: N/A | CODE: 300

3. PHOTO REFERENCE

PHOTO CREDIT: BISHOP MUSEUM

DATE OF PHOTO: JUNE 1974

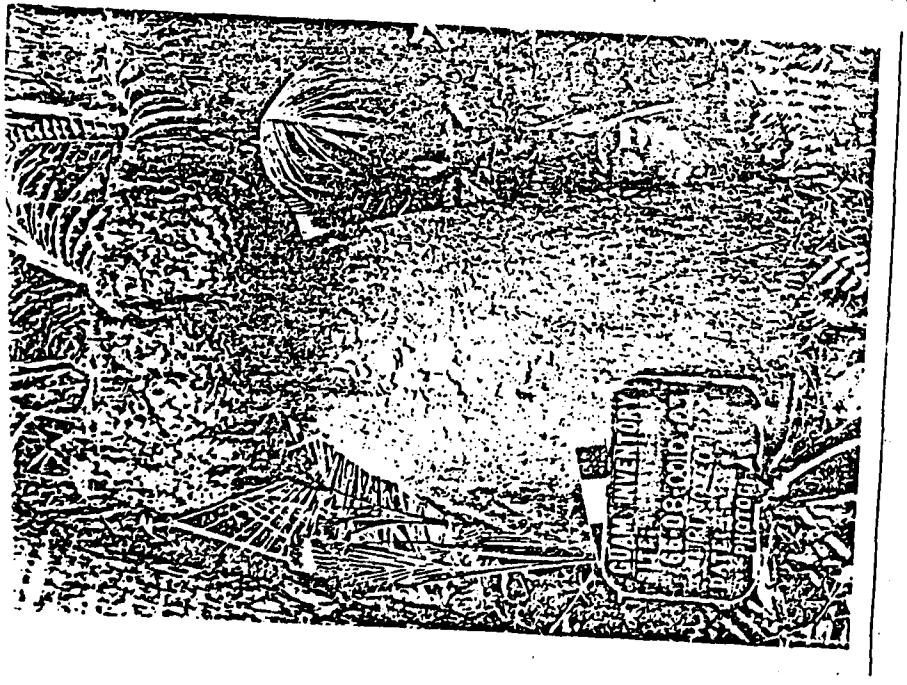
NEGATIVE FILED AT: DEPARTMENT OF COMMERCE, AGANA, GUAM

4. IDENTIFICATION

DESCRIBE VIEW, DIRECTION, ETC.

CAP AND UPRIGHT

INT: 184-72



SEE INSTRUCTIONS

8. SIGNIFICANCE

PERIOD *(Check One or More as Appropriate)*

- ☐ Pre-Columbian
- ☒ 16th Century
- ☒ 18th Century
- ☐ 20th Century
- ☒ 15th Century
- ☒ 17th Century
- ☒ 19th Century

SPECIFIC DATE(S) *(If Applicable and Known)*: possibly abandoned A.D. 1852

AREAS OF SIGNIFICANCE *(Check One or More as Appropriate)*

Aboriginal	☐ Education	☐ Political	☐ Urban Planning
☒ Prehistoric	☐ Engineering	☐ Religion/Philosophy	☐ Other *(Specify)*
☒ Historic	☐ Industry		
☐ Agriculture	☐ Invention	☐ Science	
☐ Architecture	☐ Landscape Architecture	☐ Sculpture	
☐ Art	☐ Literature	☐ Social/Humanitarian	
☐ Commerce	☐ Military	☐ Theater	
☐ Communications	☐ Music	☐ Transportation	
☐ Conservation			

STATEMENT OF SIGNIFICANCE

The Uruno site is an important and valuable site area. Although larger than the Haputo site, it has many of the same characteristics that enhances its importance. First it may be the site of an historic village called either Falcona or Fasonan, or both apparently abandoned by 1852. Further, much of the early archaeological work done on the island by Hans Hornbostel occurred at this site. One structure (66 08 0010 01) had a latte upright and brain coral cap removed by him. It is now on display at the Bishop Museum in Honolulu. Artifacts recovered are in the collection at the same museum, some of which are reported on by Laura Thompson (1932). At least 4 of the latte structures are restorable, all in the central part of the site and 2 potentially restorable wells occur with these latte. Finally, the extent of the midden and artifact materials, the presence of rock shelters and caves, and for the reconstruction of village habitation and settlement patterns on the island. Extensive excavations are recommend both for the restoration and the reconstruction of the early to historic village patterns.

At the present time, the lack of archaeological investigation for the island precludes the establishment of a firm cultural sequence. Although site remains occur from Haputo Point to Tarague Beach--except where destroyed by land clearing and construction, as at Ritidian Point--the surface remains are all from the latest periods of Guamanian prehistory. The includes the material excavated by Hornbostel in the 1920's at Uruno. The only known Historic building, the "Casa Real' was destroyed along with the historic village remains of San Miguel de Tarragui by clearing for the Naval Station at Ritidian prior to 1965.

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Thompson, Laura
1932 Archaeology of the Marianas, Bernice P. Bishop, Museum Bulletin 100 Honolulu, Hawaii 78 pp.

10. GEOGRAPHICAL DATA

LATITUDE AND LONGITUDE COORDINATES DEFINING A RECTANGLE LOCATING THE PROPERTY						OR	LATITUDE AND LONGITUDE COORDINATES DEFINING THE CENTER POINT OF A PROPERTY OF LESS THAN TEN ACRES					
CORNER	LATITUDE			LONGITUDE				LATITUDE			LONGITUDE	
	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds		Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
NW	13°	37'	09"	144°	50'	00"		°	'	"	°	'	"
NE	13°	37'	09"	144°	50'	06"							
SE	13°	36'	50"	144°	50'	06"							
SW	13°	36'	50"	144°	50'	00"							

APPROXIMATE ACREAGE OF NOMINATED PROPERTY: 13.5 acres

LIST ALL STATES AND COUNTIES FOR PROPERTIES OVERLAPPING STATE OR COUNTY BOUNDARIES

STATE:	CODE	COUNTY	CODE
STATE:	CODE	COUNTY:	CODE
STATE:	CODE	COUNTY:	CODE
STATE:	CODE	COUNTY:	CODE

11. FORM PREPARED BY

NAME AND TITLE: Guam Inventory Team

ORGANIZATION: Bernice Pauahi Bishop Museum — DATE: August 1974

STREET AND NUMBER: 1355 Kalihi Street Post Office Box 6037

CITY OR TOWN: Honolulu — STATE: Hawaii 96818 — CODE: 58

12. STATE LIAISON OFFICER CERTIFICATION

As the designated State Liaison Officer for the National Historic Preservation Act of 1966 (Public Law 89-665), I hereby nominate this property for inclusion in the National Register and certify that it has been evaluated according to the criteria and procedures set forth by the National Park Service. The recommended level of significance of this nomination is:

National ☐ State ☒ Local ☐

Name _____

Title Director of Commerce

Date SEP 09 1974

NATIONAL REGISTER VERIFICATION

I hereby certify that this property is included in the National Register.

_____
Director, Office of Archeology and Historic Preservation

Date _____

ATTEST:

_____
Keeper of The National Register

Date _____

GPO 931-804

SEE INSTRUCTIONS

(7/72)

NATIONAL REGISTER OF HISTORIC PLACES
PROPERTY PHOTOGRAPH FORM
(Type all entries - attach to or enclose with photograph)

COUNTY: N/A

FOR NPS USE ONLY
ENTRY NUMBER | DATE

SEE INSTRUCTIONS

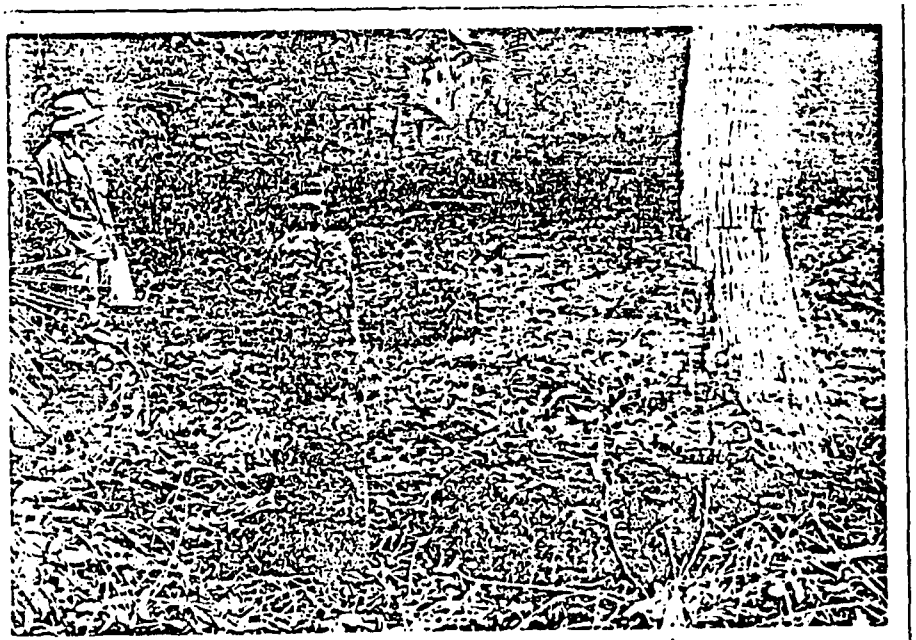
1. NAME
COMMON: URUNO
AND/OR HISTORIC: FALCONA, FASONAN, ORUNO

2. LOCATION
STREET AND NUMBER: 0.7 MILES SOUTHWEST OF URUNO POINT
CITY OR TOWN: DEDEDO
STATE: GUAM — CODE: 66 — COUNTY: N/A — CODE: 300

3. PHOTO REFERENCE
PHOTO CREDIT: BISHOP MUSEUM
DATE OF PHOTO: JUNE 1974
NEGATIVE FILED AT: DEPARTMENT OF COMMERCE, AGANA, GUAM

4. IDENTIFICATION
DESCRIBE VIEW, DIRECTION, ETC.
LATTE SET

INT: 184-72



Form 10-300 (Rev. 6-72)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES INVENTORY – NOMINATION FORM

(Type all entries - complete applicable sections)

STATE: Guam
COUNTY: N/A
FOR NPS USE ONLY
ENTRY DATE:

1. NAME
COMMON: Uruno Beach
AND/OR HISTORIC:

2. LOCATION
STREET AND NUMBER: 0.9 Miles Southwest of Achae Point
CITY OR TOWN: Dededo
CONGRESSIONAL DISTRICT: Guam
STATE: Guam — CODE: 66 — COUNTY: N/A — CODE:

3. CLASSIFICATION

CATEGORY (Check One)	OWNERSHIP	STATUS	ACCESSIBLE TO THE PUBLIC
☐ District ☐ Building ☒ Site ☐ Structure ☐ Object	☐ Public ☒ Private ☐ Both Public Acquisition: ☐ In Process ☒ Being Considered	☐ Occupied ☒ Unoccupied ☐ Preservation work in progress	Yes: ☒ Restricted ☐ Unrestricted ☐ No

PRESENT USE (Check One or More as Appropriate)

☐ Agricultural	☐ Government	☐ Park	☐ Transportation	☐ Comments
☐ Commercial	☐ Industrial	☐ Private Residence	☒ Other (Specify) Unused	
☐ Educational	☐ Military	☐ Religious		
☐ Entertainment	☐ Museum	☐ Scientific		

4. OWNER OF PROPERTY
OWNER'S NAME: Jose C. Artero, Antonio C. Artero, Consuelo A. Calvo
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DEPOSITORY FOR SURVEY RECORDS: Department of Commerce
STREET AND NUMBER: Post Office Box 682
CITY OR TOWN: [illegible] — STATE: Guam 96910 — CODE: 66

SEE INSTRUCTIONS

Rev. 7-72

NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES PROPERTY MAP FORM

(Type all entries - attach to or enclose with map)

COUNTY: N/A
FOR NPS USE ONLY
ENTRY NUMBER: DATE:

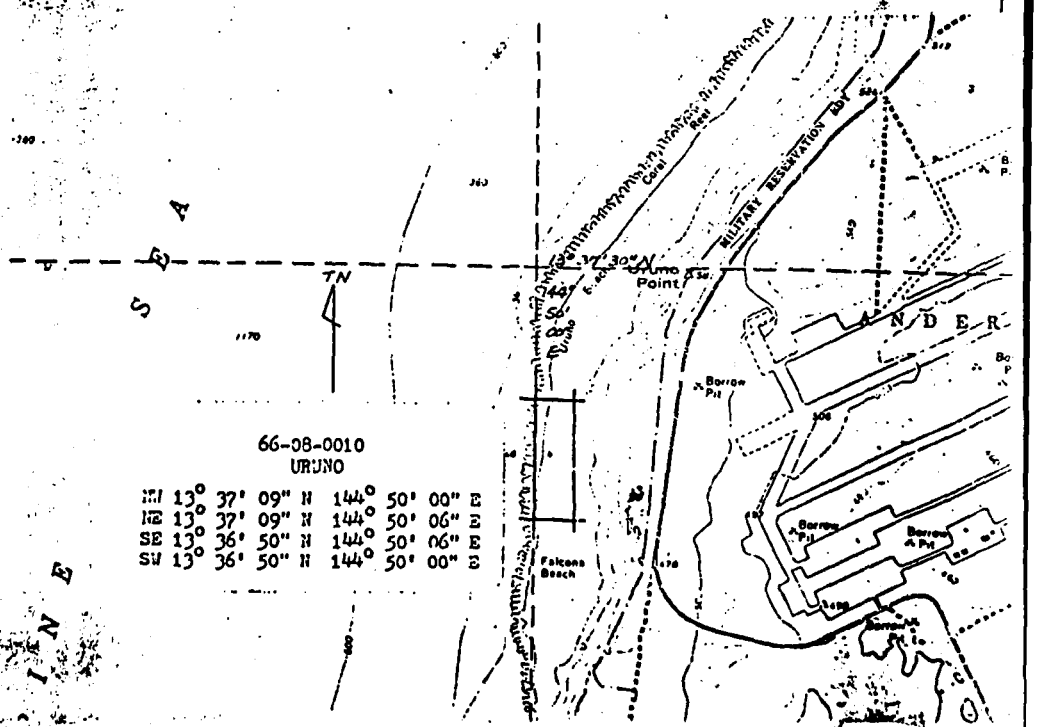
1. NAME
COMMON: Uruno
AND/OR HISTORIC: Falcona, Fasonan, Oruno

2. LOCATION
STREET AND NUMBER: 0.7 miles Southwest of Uruno Point
CITY OR TOWN: Dededo
STATE: Guam — CODE: 66 — COUNTY: N/A - — CODE: 300

3. MAP REFERENCE
SOURCE: U.S.G.S. 7.5' Series Ritidian Point Quadrangle
SCALE: 1:24000
DATE: 1968

4. REQUIREMENTS
TO BE INCLUDED ON ALL MAPS
1. Property boundaries where required.
2. North arrow.
3. Latitude and longitude reference.

★ U.S. GOVERNMENT PRINTING OFFICE : 1973—729-148/1441 3-1



SEE INSTRUCTIONS

6. SIGNIFICANCE

PERIOD (Check One or More as Appropriate)

- [X] Pre-Columbian
- [ ] 15th Century
- [ ] 16th Century
- [ ] 17th Century
- [ ] 18th Century
- [ ] 19th Century
- [ ] 20th Century

SPECIFIC DATE(S) (If Applicable and Known)

AREAS OF SIGNIFICANCE (Check One or More as Appropriate)

- [ ] Aboriginal
- [X] Prehistoric
- [ ] Historic
- [ ] Agriculture
- [ ] Architecture
- [ ] Art
- [ ] Commerce
- [ ] Communications
- [ ] Conservation
- [ ] Education
- [ ] Engineering
- [ ] Industry
- [ ] Invention
- [ ] Landscape Architecture
- [ ] Literature
- [ ] Military
- [ ] Music
- [ ] Political
- [ ] Religion/Philosophy
- [ ] Science
- [ ] Sculpture
- [ ] Social/Humanitarian
- [ ] Theater
- [ ] Transportation
- [ ] Urban Planning
- [ ] Other (Specify) _____

STATEMENT OF SIGNIFICANCE

The Uruno Beach site, like others along the NW coast of Guam appears to have been a heavily occupied area formerly. The large amounts of pottery and other living debris, and 3 large wells, indicate a site of some importance prehistorically. The single restorable structure, as well as the apparently fewer latte structures mean the site is less interesting from a restoration and developmental point of view than either Uruno (66 08 0010) or Haputo (66 03 0007), also on this coast. Nevertheless, the archaeological research potential is very good and a program of excavations is recommended.

At the present time, the lack of archaeological investigation for the island precludes the establishment of a firm cultural sequence. Although site remains occur from Haputo Point to Tarague Beach--except where destroyed by land clearing and construction, as at Ritidian Point--the surface remains are all from the latest periods of Guamanian prehistory. The includes the material excavated by Thompson[1] in the 1920's at Uruno. The only known historic building, the "Casa Real" was destroyed along with the historic village remains of San Miguel de Tarragui by clearing for the Naval Station at Ritidian prior to 1965.

SEE INSTRUCTIONS

7. DESCRIPTION

CONDITION (Check One)

- [ ] Excellent
- [X] Good
- [ ] Fair
- [ ] Deteriorated
- [ ] Ruins
- [ ] Unexposed

(Check One)

- [ ] Altered
- [X] Unaltered

(Check One)

- [ ] Moved
- [X] Original Site

DESCRIBE THE PRESENT AND ORIGINAL (If Known) PHYSICAL APPEARANCE

The Uruno Beach site is located at the base of the cliffs on the NW coast of the island from ca. 500 m S of Uruno Point (DH581) to Achae Point on the N. The southern part of the site is called Uruno Beach on the USGS *Ritidian Point Quadrangle Map* (1968). It is on the property of Jose C. Artero of Agana. It may be reached by driving N on Highway 3 from Potts Junction, 3.2 miles to a paved, but badly deteriorated road .5 miles S of Uruno Point which leads W to the cliffs. A steep trail leads down to Mr. Artero's ranch and the Uruno site (66 08 0010). Walk N on the beach ca. 400-450 m to reach the southern end of the Uruno Beach site.

The site is ca. 2200 m long and 100-150 m wide at the southern end, and covers the 20-40 foot contours. The heaviest concentrations of remains occurs in the southernmost 1200 to 1500 m of the site, at least 6 sets of latte occur here, most badly deteriorated and/or disturbed. A single set was recordable (66 08 0010 01). Several of the disturbed sets were small 4 stone set, rather than the more usual large latte. In addition, at least 3 large wells, ca. 10 m in diameter and still retaining remnants of the former stone facing on them were noted. Scattered pottery, with heavier concentrations in low and stone tool fragments, and other midden debris are also a part of the site remains. Rock shelters are found along the cliffs in the eastern part of the site.

The soil of the site is brown to black sand and sandy clay, containing scattered limestone pebbles and other beach debris.

Vegetation consists mostly of coconut (Cocos nucifera) and Pandanus sp., but "limon-china" (Triphasia sp.) and Mammea sp. as well as other small shrubs and vines occur.

The latte uprights and caps are the stone house posts upon which the houses of the earlier inhabitants of the Marianas Islands were built. Generally, trapezoidal in outline, the pillars are capped by a semi-hemispherical capstone, on which the floor beams of the houses were placed. The uprights are arranged in relatively evenly spaced pairs which form two parallel rows of from 4 to 14 stones; 8 and 10 stone structures are the most common on any given site. It is also thought that only the most important structures in a settlement were built on these latte foundations; other dwellings being built on wooden house posts or on the ground. The stone mortars which are found in association with the latte structures, were used during historic and probably prehistoric times for the processing of rice. Other foods requiring grinding during processing include the cycad (Cycas circinalis). These nuts were an important source of food during earlier times and may have been processed in the mortars as well.

History begins on Guam after 1521 A.D. with most historic villages being developed after the first permanent settlement in 1668. Archaeologically, these historic villages may be distinguished by the presence of non-native artifacts and manufacturing techniques including metal and wheel-made and kiln-fired pottery.

SEE INSTRUCTIONS

Form 10-300a
(July 1969)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES
INVENTORY - NOMINATION FORM

(Continuation Sheet)

STATE	
Guam	
COUNTY	
N/A	
FOR NPS USE ONLY	
ENTRY NUMBER	DATE

(Number all entries)

6. REPRESENTATION IN EXISTING SURVEYS

Title: Archaeology and History of Guam
Date: 1952
Type: Federal Survey
Records: U.S. Department of the Interior

GPO 921-774

9. MAJOR BIBLIOGRAPHICAL REFERENCES

Thompson, Laura
1932 Archaeology of the Marianas. B.P. Bishop Museum Bulletin 100, Honolulu, Hawaii 78 pp.

10. GEOGRAPHICAL DATA

LATITUDE AND LONGITUDE COORDINATES DEFINING A RECTANGLE LOCATING THE PROPERTY						OR	LATITUDE AND LONGITUDE COORDINATES DEFINING THE CENTER POINT OF A PROPERTY OF LESS THAN TEN ACRES					
CORNER	LATITUDE			LONGITUDE				LATITUDE			LONGITUDE	
	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds		Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
NW	13°	38'	19"	144°	50'	41"		°	'	"	°	'	"
NE	13°	33'	17"	144°	50'	51"							
SE	13°	37'	26"	144°	50'	09"							
SW	13°	37'	26"	144°	49'	59"							

APPROXIMATE ACREAGE OF NOMINATED PROPERTY: 54.3 acres

LIST ALL STATES AND COUNTIES FOR PROPERTIES OVERLAPPING STATE OR COUNTY BOUNDARIES

STATE:	CODE	COUNTY	CODE
STATE:	CODE	COUNTY:	CODE
STATE:	CODE	COUNTY:	CODE
STATE:	CODE	COUNTY:	CODE

11. FORM PREPARED BY

NAME AND TITLE: Guam Inventory Team

ORGANIZATION: Bernice P. Bishop Museum — DATE: August, 1974

STREET AND NUMBER: 1355 Kalihi St., Post Office Box 6037

CITY OR TOWN: Honolulu — STATE: Hawaii 96819 — CODE: 33

12. STATE LIAISON OFFICER CERTIFICATION

As the designated State Liaison Officer for the National Historic Preservation Act of 1966 (Public Law 89-665), I hereby nominate this property for inclusion in the National Register and certify that it has been evaluated according to the criteria and procedures set forth by the National Park Service. The recommended level of significance of this nomination is:

National ☐ State ☒ Local ☐

Name _____

Title Director of Commerce

Date _____

NATIONAL REGISTER VERIFICATION

I hereby certify that this property is included in the National Register

_____
Director, Office of Archeology and Historic Preservation

Date _____

ATTEST:

_____
Keeper of The National Register

Date _____

SEE INSTRUCTIONS

* U.S. GOVERNMENT PRINTING OFFICE : 1971-729-147/1442 3-4

Form No. 10-301
Rev. 7-72

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES
PROPERTY MAP FORM

(Type all entries - attach to or enclose with map)

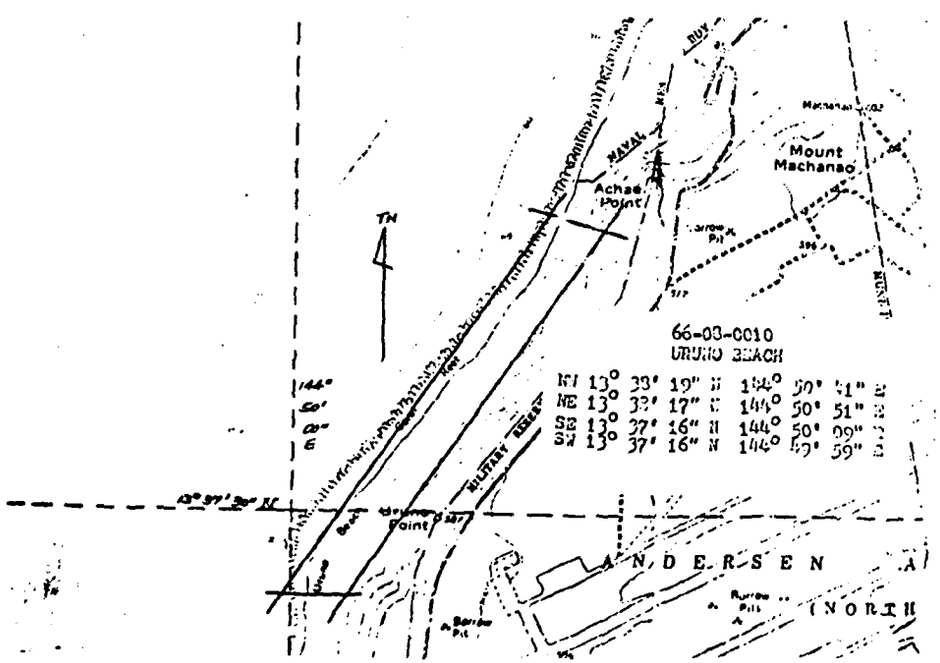
STATE	
Guam	
COUNTY	
N/A	
FOR NPS USE ONLY	
ENTRY NUMBER	DATE

SEE INSTRUCTIONS

1. NAME
   - COMMON: Urunao Beach
   - AND/OR HISTORIC:
2. LOCATION
   - STREET AND NUMBER: 0.9 Miles Southwest of Achae Point
   - CITY OR TOWN: Dededo
   - STATE: Guam — CODE: 66 — COUNTY: N/A — CODE: 300
3. MAP REFERENCE
   - SOURCE: U.S.G.S. 7.5' Series Ritidian Point Quadrangle
   - SCALE: 1:24000
   - DATE: 1968
4. REQUIREMENTS

TO BE INCLUDED ON ALL MAPS
1. Property boundaries where required.
2. North arrow.
3. Latitude and longitude reference.

U.S. GOVERNMENT PRINTING OFFICE : 1973-729-148/1441 3-4



Form No. 10-301a
(7/72)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES
PROPERTY PHOTOGRAPH FORM

(Type all entries - attach to or enclose with photograph)

Guam	
COUNTY	
N/A	
FOR NPS USE ONLY	
ENTRY NUMBER	DATE

SEE INSTRUCTIONS

1. NAME
   - COMMON: Urunao Beach
   - AND/OR HISTORIC:
2. LOCATION
   - STREET AND NUMBER: 0.9 miles Southwest of Achae Point
   - CITY OR TOWN: Dededo
   - STATE: Guam — CODE: 66 — COUNTY: N/A — CODE: 300
3. PHOTO REFERENCE
   - PHOTO CREDIT: Bishop Museum
   - DATE OF PHOTO: June 1974
   - NEGATIVE FILED AT: Department of Commerce, Agana, Guam
4. IDENTIFICATION
   - DESCRIBE VIEW, DIRECTION, ETC.

Latte Set

INTI 184-72

Photograph 1. Site 66-08-0010-03, Urunao Complex, a 6-stone latte site with one capstone in place (possibly placed by Hornbostel in the 1930's).

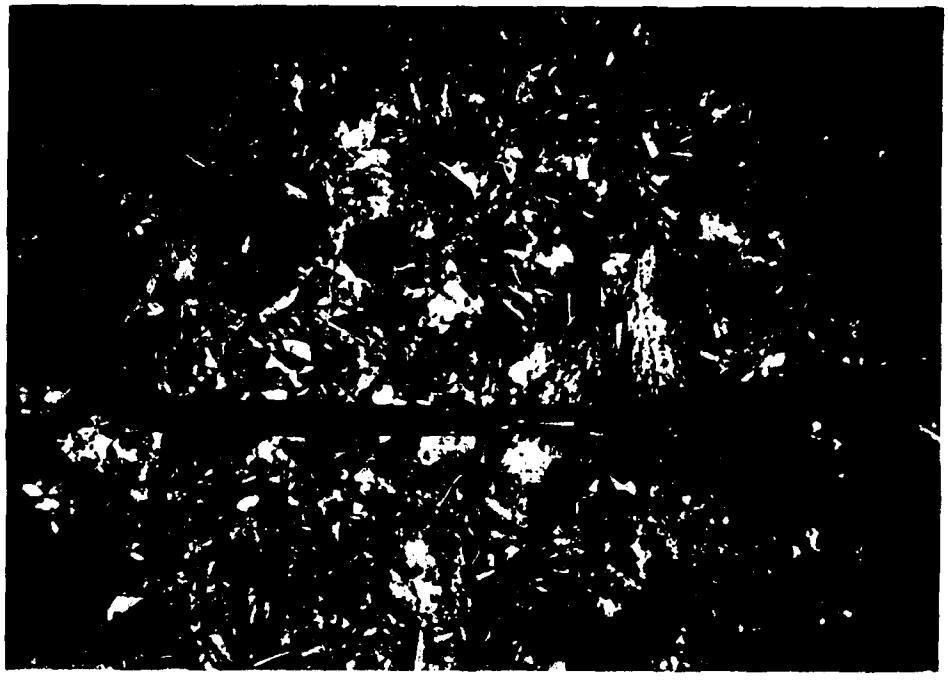
Photograph 2. Site 66-08-0010-01, Urunao Complex, portion of a 8-stone latte site near the main trail to the beach (one latte was removed by Hornbostel in the 1930's and is now on the grounds of Bishop Museum, Honolulu).

Photograph 3. Site 66-08-0010-02, Uruno Complex, portion of a 8-stone latte site visible in the background. John Salas of the Guam Territorial Archaeology Laboratory in the foreground.

Photograph 4. Previously unidentified latte site situated south-southwest of the other latte in Site 66-08-0010.

Photograph 5. Site 66-08-0010-04, Uruno Complex, large prehistoric well hole containing partial stone alignments at the base and along sides. John Salas standing in the center.

Photograph 6. Crude platforms and cleared areas on a limestone ledge along the lower slopes of the Uruno cliffs downslope from Dumpsite #1 and #2.



Photograph 7. Possible portion of a Japanese-made, World War II hand grenade (above the machete) among other debris littering the limestone ledge directly above the beach at Uruno Point.

Photograph 8. American manufactured ordnance fragment in the same general vicinity as that pictured above.